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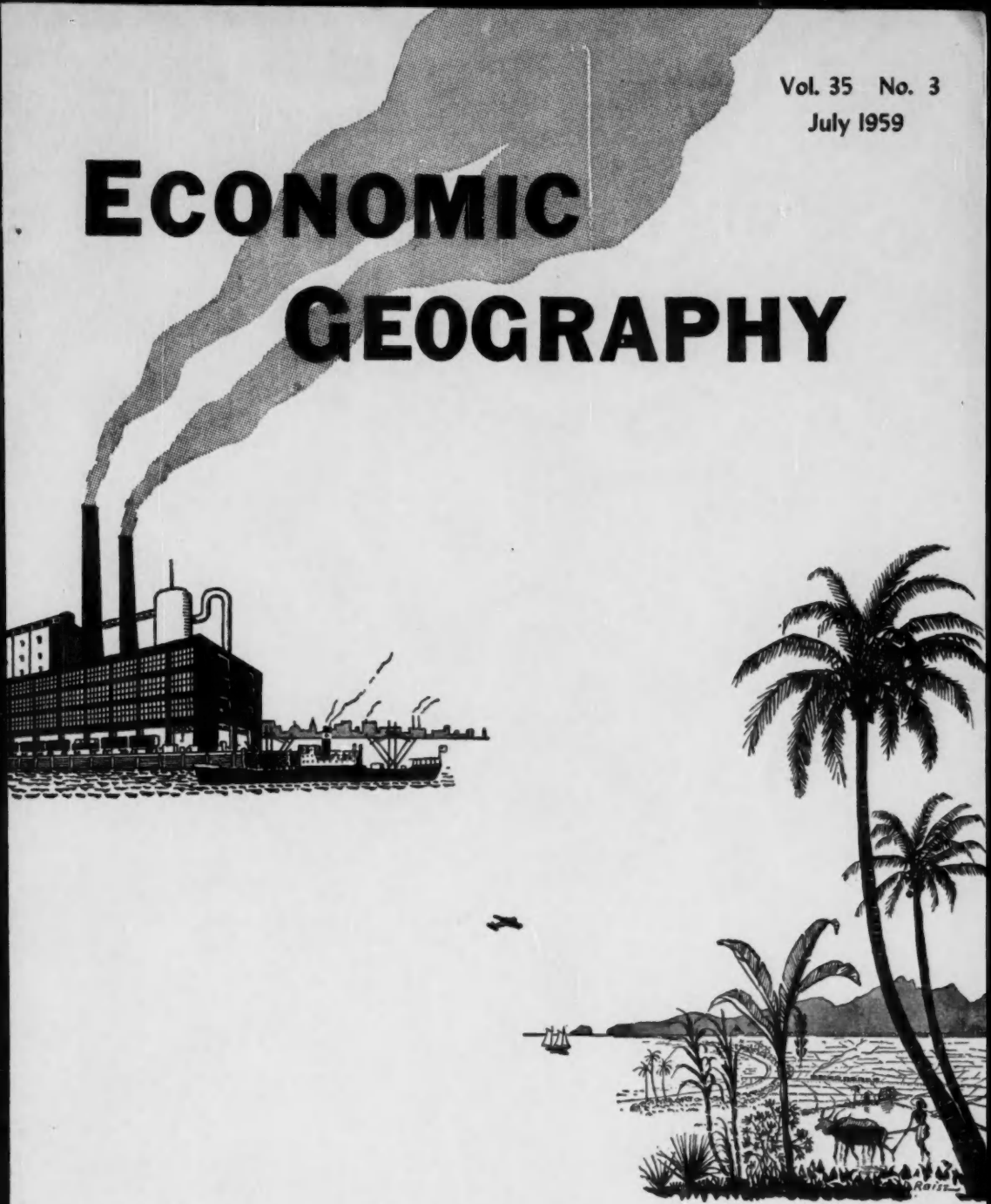

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ECONOMIC GEOGRAPHY

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THE CHANGING RELATIONSHIPS OF ECONOMICS AND ECONOMIC GEOGRAPHY

Robert B. McNee

Dr. McNee is Assistant Professor of Economic Geography at The City College, New York. As a geographer in an economics department he has had an excellent background for the paper here presented.

THE vigorous growth of economic geography will be stimulated and enhanced by clarification of its relationships with a sister discipline, economics. These relationships are not self-evident, despite the avowed common interest in economic phenomena. This fact has been noted by many geographers, including Wooldridge and East,[1] Stamp,[2] Finch,[3] Murphy[4], and Fisher.[5] Some geographers have discussed not only existing relationships but also what they believe these relationships *ought to become*. Ballabon[6] wants a more "economic" economic geography while Lukermann[7] urges a more "geographic" economic geography. What sort of relationships *should* geographers try to develop with economics? Or, to put the matter differently, how much economics can economic geographers use? The purpose of this paper is to throw light on these questions by examining the historically changing relationships of the two fields in terms of disciplinary central problems and their changing social setting.

This article is concerned with *central problems* rather than with disciplinary definitions. Central problems have been described as disciplinary cores,[8] core topics, and target centers.[9] These are the questions that geographers or economists seek to unravel and to answer. They have a clarity and precision normally lacking in definitions. To be inclusive, definitions must be so broad and so generalized that they often conceal more than they reveal. At best, definitions are static descriptions, while central problems reveal the *direction* of disciplinary growth. The starting point for any discipline is the clear perception of a problem; the field grows as a meth-

[1] S. W. Wooldridge and W. G. East: "The Spirit and Purpose of Geography," London, 1951, pp. 103–120.

[2] J. C. Stamp: "Geography and Economic Theory," *Geography*, Vol. 22, 1937, pp. 1–13.

[3] V. C. Finch: "Training for Research in Economic Geography," *Annals Assn. of Amer. Geogrs.*, Vol. 24, 1944, pp. 207–215.

[4] Raymond E. Murphy: "The Fields of Economic Geography," *American Geography: Inventory and Prospect* (James and Jones, Edits.), Syracuse, 1954, pp. 240–245.

[5] C. A. Fisher: "Economic Geography in a Changing World," *Trans. and Papers of the Inst. of Brit. Geogrs.*, 1948, pp. 69–85.

[6] M. B. Ballabon: "Putting the 'Economic' into Economic Geography," *Econ. Geogr.*, Vol. 33, 1957, pp. 217–223.

[7] F. Lukermann: "Toward a More Geographic Economic Geography," *Prof. Geogr.*, Vol. 10, 1958, pp. 2–10.

[8] Nevin Fenneman: "The Circumference of Geography," *Annals. Assn. Amer. Geogrs.*, Vol. 9, 1919, pp. 3–11.

[9] Edward L. Ullman: "Human Geography and Area Research," *Annals Assn. Amer. Geogrs.*, Vol. 43, 1953, pp. 54 and 56.

odology is developed which is relevant to the problem and as awareness of the ramifications of the problem leads to the examination of related problems.

Central problems must be examined in terms of their social setting. They are essentially meaningless except in terms of the societies which have given them birth and nourished them. Like most social scientists, economist and geographers are likely to cultivate those central problems most pertinent to the society of which they are members. Therefore, historical changes in the circumstances, structure, and problems of society are important in understanding the evolution of the two disciplines and the changing relationships between them. These changes may be summarized briefly in terms of two time periods: (1) The Age of European Commercial Expansion, during which economic geography and classical economics developed as isolated but complementary disciplines, and (2) the present Urban–Industrial Age, during which the two fields have broadened and have moved from complementarity toward cooperation.

EUROPEAN COMMERCIAL EXPANSION

The remarkable commercial transformation of Europe and the world after the 15th Century created new social, economic, and political problems. These problems were not easily resolved in terms of the pre-Columbian thought patterns of Europeans. Many new branches and divisions of thought gradually evolved in the attempt to understand and cope with these problems, economics and economic geography among them.

Two dominant characteristics of the Occidental system were the growth of markets and the global expansion of the commercial powers of Europe. The opening of the world in the 15th Century began a 400-year boom, perhaps not yet ended. The so-called "Commercial Revolution" reshaped Europe from within. Old centers of production and consumption withered away; new trade centers flourished where isolated farming and fishing villages had been. The geographic reshuffling which occurred in the British Isles created, in a sense, a new country. The expansion of the system over the earth created a new world, a universe of exchange. The struggles between political states were primarily struggles for control of this exchange world, struggles for trading and resource space on the surface of the earth. Economics developed as the study of one aspect of the system, the market mechanism, while economic geography developed as the study of another aspect of the system, the consequent complexity of economic similarities and differences among areas within the global system.

The Interpretations of Classical Economics

Economics as we know it grew out of a great social need, the need to harmonize the Medieval logic of the "schoolmen" with the changed conditions of the market-dominated Age of Trade. Economists (originally political economists) sought to solve two closely related social problems. They sought a value basis for the formulation of social policy, and they sought the most efficient economic means to carry out social policy. They were both social philosophers and efficiency experts. As a part of the classical system of economic logic, they developed an elaborate Benthamite "economics of welfare." This welfare concern has been primarily with people as consumers rather than as producers. As Robert Solo has pointed out, Communists and Capitalists alike have taken consumer interest as the . . . "full and sufficient standard for the ultimate evaluation of alternative eco-

nomic systems."[10] Thus, although economists from Adam Smith onwards have been interested in production, consumption has been emphasized more than production. As efficiency experts, economists have been concerned broadly with the economizing problem, the proper allocation of scarce means (resources) to social ends. In analyzing this problem, the economists developed the familiar concepts of land, labor, and capital.

Economics developed as a deductive system of logic. It was strongly influenced by the "rational thinking" of the 18th Century, especially in England and America. It has tended to be more abstract and less empirical and descriptive than other social sciences such as economic geography or sociology which were more influenced by the "Darwinian thinking" of the 19th Century. Economics has attained great intellectual heights in the building of abstract models, though these models have not always been tested in the real world. Perhaps many of them are not testable. Nevertheless, these models are of great value in interpreting, if not predicting, economic behavior in the real world. As guiding hypotheses, they are superior to anything else thus far developed in the social sciences.

Most economic models are tools for analyzing the market. This emphasis on the market has been quite appropriate, since historically the market has been the principal mechanism for resource allocation in the Occidental world. With the commercial expansion of Europe, it soon became apparent that markets were not only the central mechanism of the Occidental system, they were also a key to understanding and controlling it. Since the economic theorist was interested in the market *qua* the market, entirely apart from the extremely complex web of historical and geographical circumstances in which a particular market might be embedded, both temporal and spatial variables could be assumed as constants in order to concentrate on such variables as demand, supply, and price. This reduction of variables may seem a gross oversimplification to geographers, but it permitted the growth of an organized system of economic theory appropriate to the understanding of many market problems. After successful static models were developed, many economists turned to the making of dynamic models. Few have shown similar interest in reintroducing the spatial variable, a tendency described by Isard as the Anglo-Saxon bias.[11]

The elimination of the spatial variable from serious consideration in economic theory decisively separated economics from geography. Although early economists such as Adam Smith filled their works with geographic or spatial suggestion and inference, the gradual refinement of theory created a highly abstract, spaceless, world. According to the concept of perfect competition, innumerable, rational, well-informed buyers met innumerable, rational, well-informed sellers in a single (spaceless) market to exchange goods and services, thus establishing prices, incomes, and the allocation of resources. Classical trade theory, as exemplified by the so-called "law of comparative advantage," assumes several production and consumption points, but spatial characteristics remain irrelevant to the theory. Various economists, such as Loesch, Weber, Ohlin, and Myrdal,[12] have shown the weaknesses of spaceless trade theory but without developing a spatial trade theory fully acceptable to general economics.

[10] Robert Solo:, "A New Direction for Economic Inquiry," *Social Sci.*, Vol. 29, 1954, p. 135.

[11] Walter Isard: *Location and the Space Economy*, New York, 1956, p. 24ff.

[12] Gunnard Myrdal: *Rich Lands and Poor: The Road to World Prosperity*, New York, 1958.

The elimination of the spatial variable from theoretical economics also left a serious void in economic interpretations of economic growth. Was it not the "conquest of space" by the use of the new technology (sailing ships) that shifted England and the Low Countries from positions on the economic margin of Europe, from the edge of the world, to the economic center of the world? Was it not English awareness of the importance of spatial mobility (sea power) that led England to world dominion? In short, it would appear that the spaceless nature of English economic theory did not stop the empirical English from "blundering through" to the establishment of a spatial system of international trade linking those parts of the world readily accessible to salt water ports. Perhaps it was the very ease of transport on the broad and limitless oceans which led English economists to consider accessibility almost entirely in terms of political "interferences" with trade (tariffs, etc.) and to ignore the limitations of distance and natural barriers. At any rate, it is significant that more interest has been shown in location theory in the more self-contained, land-based, economies such as those of Germany, the Soviet Union, and the United States. Alternatively, one might assume the economist's lack of concern for spatial variability to be caused by ethnocentrism. It might appear eminently reasonable to think in terms of *a market* rather than many markets when England was unquestionably the industrial and market center of the world, when cotton prices were determined almost exclusively in Liverpool and Manchester. Further, Britain was such a small country that spatial variation within it might appear unimportant in comparison with the total volume of sea-borne trade. However, Myrdal considers the problem to be more basic, a moral problem. He suggests that behind the neat abstractions of classical trade theory lay the desire to avoid consideration of the morally embarrassing economic inequalities among the (spatially differentiated) countries of the world. In any case, the growth of economic geography has been, at least in part, an attempt, conscious or unconscious, to fill the vacuum created by the elimination of the spatial variable from economic theory.

The Interpretations of Economic Geography

The beginnings of economic geography were quite different than those of economics. While economics grew from the social philosophy of the Middle Ages, economic geography developed from Medieval cosmography and from the intellectual reaction of the Europeans to a suddenly expanded world. The Ancient and Medieval Worlds were small worlds. Although there was considerable spatial variation, this variability was very minor in relation to the immensely varied and seemingly limitless world which opened out before the adventurous Europeans of the 16th Century. Greek and Arab geographers had begun the analysis of earth space, but this analysis was largely cartographic and descriptive rather than abstract and theoretical. Consequently there were relatively few theoretical foundations on which to build spatial understanding in the post-Columbian era, while the need to develop such understanding was immediate and pressing. Thus perhaps it is not surprising that the classical economists developed abstract models without including an important abstraction, spatial variability, whereas geographers began empirical study of the newly important spatial variability.

The great outpouring of maps, atlases, and geographies or cosmographies witnessed to the need of the Europeans to understand the areal differentiation

of the world they were exploring and organizing for world-wide trade. Most of this geography was general, not confining itself solely to economic spatial variation. Though Alexander Von Humboldt is best known for his studies of biological geography, he also studied the "economic geography" of the Spanish Colonial Empire. The great surveys of western North America had a partially economic orientation. Many geographic studies of the habitable world and of the limits of the agricultural frontier revealed a strong interest in the geography of Occidental economic expansion.

The great expansion of world-wide trade, the gradual erosion of isolation, and the rise of the commercial vocational school[13] have led toward a more specifically "economic" type of geography. J. C. Stamp has suggested that the real parentage of modern American economic geography is in ". . . the Eighteenth Century masses of unrelated [i.e., conceptually unrelated] facts . . . everything useful for the merchant to know."[14] This early commercial geography was undeniably useful but had little coherence and few organizing principles. Thus when Götz called for the development of *economic geography* in 1882, he was most careful to distinguish it from practical but unsystematic "commercial geography." However, the commercial geography despised by Götz became closely identified with the new economic geography, at least in England and America. But commercial geography did not remain without principles and organization. Perhaps it is not wholly accidental that a more scholarly commercial geography developed in Great Britain, the chief trading nation. This geography flourished at the turn of the century under the leadership of Chisholm in Great Britain and Whitbeck and Smith in the United States. It stressed the study of trade routes, the production and movement of commodities, and the character of economically specialized production areas, especially agricultural regions. Production, rather than consumption, was emphasized. According to Sapper,[15] the geography of consumption was not clearly defined until 1929, by Schmidt. Primary production was treated in some detail, but secondary and tertiary production received little attention. The natural environment was fully treated, not only because of the pervasive environmental determinism (really a form of Social Darwinism) of the period, but also because the natural environment is highly pertinent to most forms of primary production. Thus the American economic geography of the early 20th Century was primarily a naturalistic geography of primary production, especially production important to trade.

Few theories and few generally acceptable verbal generalizations were produced. As a pioneering field, geography was concerned primarily with bringing order out of chaos by careful classification and mapping of economic phenomena. However, geographers developed the map as a highly effective form of visual generalization. They learned to state economic problems in cartographic form; as H. H. McCarty has pointed out, an adequately annotated and properly documented map may constitute the statement of a research problem in economic geography. Further, the many studies of small areas produced generalizations which could then become hypotheses for the study of other areas, a process which could eventually lead to the development of gen-

[13] Sidney Rosen: "A Short History of High School Geography," *Journ. of Geogr.*, Vol. 56, 1957, pp. 406–413.

[14] J. C. Stamp, *op. cit.*, p. 3.

[15] Karl Sapper: "Economic Geography," *Encyclopedia of the Social Sciences*, Vol. 6, pp. 626–628.

eralizations and principles applicable to large areas of the earth.[16]

Economics and Economic Geography Compared

The economics and economic geography which had developed by the early decades of the 20th Century were very different. They were complementary though not highly cooperative. Geographers took the market as a research perimeter while economists took areal differentiation as a research perimeter. Thus geographers discussed the production and flow of primary materials without market analysis while the economists analyzed markets without regard for their spatial variability. Similarly, geographers stressed primary production while the economists stressed consumption. Economists were generally more sensitive to social values, though some geographers were pioneers in the study of conservation. Economic geography was largely empirical; economics was highly abstract. The differences between the two fields were too great to be satisfactorily bridged at the level of theory. Yet the central problems of the two fields were interrelated parts of a larger social problem. Both fields sought to understand the same basic phenomenon, the world market economy created by European expansion. The vacuums in knowledge created by the disciplinary structure of one field were filled, at least in part, by the efforts of the other. Thus, although the two fields developed in isolation from each other and although little cooperation of a formal nature emerged, economics and economic geography were complementary disciplines.

THE URBAN-INDUSTRIAL WORLD AND THE BROADENING OF INQUIRY

The related processes of the new industrialization and urbanization gradually have transformed the relatively simple agro-commercial world of western expansion into a new and much more complex world. This new urban-industrial world differs from its predecessor almost as much as the age of Occidental expansion differed from the fragmented and isolated Medieval World. The new age of industrial chemistry, electricity, and the internal combustion engine has brought new social problems and a new relevancy and urgency to old social problems. The importance of trade between developed and underdeveloped regions has declined, while the importance of trade within and among developed regions has increased. Energy sources and their location have new meaning for industrial location with each passing day. Economic localism and atomization have given way to giant corporate industrial combines, agencies of the state in totalitarian countries and semi-independent corporations in the rest of the world. The old, compact city and the old urban-rural dichotomy are giving way to something new, something as yet so dimly understood that it is without a generally accepted name (suburbia-exurbia, urban region, urban agglomeration, conurbation, megalopolis, and so on). In short, society is struggling with the new meaning of space and with the creation of a social order appropriate to this new meaning.

The attempt to probe the new problems of society has already influenced economic geography and economics profoundly. Both disciplines have broadened the field of inquiry, adding many new branches and specialties. Yet the central interests of the past remain. Economics is still concerned with resource allocation and hence with the functioning of the market mechanism, economic geography with *production*

[16] H. H. McCarty: "An Approach to a Theory of Economic Geography," *Econ. Geogr.*, Vol. 30, 1954, pp. 95–101.

geography.[17] However, while the cores remain distinct, the broadening of inquiry has led to much overlapping of interest. Historic distinctions have become hazy in many areas peripheral to both fields.

The Broadening of Economics

Some of the very evident broadening of economics can be traced rather directly to the great economic crises of the day, in an era of increasing economic complexity with the consequent need for planning in business, labor, and government. The great economic crises of the 20th Century include the endemic agricultural crisis, the Great Depression, and the two World Wars. The first has fostered a great expansion of both theoretical and applied studies in agricultural economics. Some of these studies have been market-oriented, closely related to the traditional central theme of economics. Others have been production-oriented, and consequently related not only to economics but also to traditional agricultural geography.

The Great Depression fostered the rise of Keynesian economics and its statistics, the analysis of National Income. The Occidental world was faced with an unparalleled problem in unemployment, a crisis presumably due to the malfunctioning of one aspect of the historic market system, savings and investment. Keynesian economics and the analysis of national income were the tools for understanding and solving this newly relevant social problem. Unfortunately, this great forward step in economics had little immediate relevance for geography. At this time geographers were preoccupied with studies of small areas rather than with gross national aggregates. The geographic emphasis on small-area studies may have been prompted primarily as a reaction to the earlier environmental determinism in geography, as Warntz[18] suggests. However, geographers were responding also to the depression-born need for active social intervention in the economy. The change in geography from environmental determinism to resource inventory and analysis was related to the change from laissez-faire economics to Keynesian analysis. Both fields were influenced by the crisis, though in different ways.

The two World Wars involved many economists in the war mobilization of resources and in regional international economic planning. The activity of economists in such international programs as the Marshall Plan, the Colombo Plan, the World Bank, and the Technical Assistance programs generated interest in regional economics. The Cold War magnified the problem of great international discrepancies in levels and rates of economic development and encouraged economists to search widely for explanations. All of these developments have very direct bearing on economic geography.

The emphasis on planning may partially account for the renewed interest in the economics of location by a few economists. Walter Isard seeks to harmonize the various location theories, especially those developed by German economists. Although his first volume is the best summary of the literature on location and although Isard contributes many ideas of his own, it is important to stress that this is not yet a truly general theory of location. It is an exceedingly important step in the development of a *market* theory of location. That is, Isard successfully relates location theory to established equili-

[17] Howard F. Gregor: "German vs. American Economic Geography," *Prof. Geogr.*, Vol. 9, 1957, pp. 12–13.

[18] William Warntz: "The Unity of Knowledge, Social Science, and the Role of Geography," address at the geography session, National Council for the Social Studies, Pittsburgh, 1957.

brium theory and to the concept of monopolistic competition. Thus the economics of location is market-oriented and remains in the economic tradition of emphasis on the market mechanism. Perhaps the growth of a more general theory must await the further development of economic explanations of production and productivity. Furthermore, Isard's space is largely abstract; it is not the real earth-space of the geographer. Nevertheless, the re-introduction of the spatial variable removes one of the major obstacles to cooperation between economics and economic geography.

The emphasis on planning may also account for the increasing interest in the economics of production. Economists have always been interested in production but interest in production and productivity *per se*, apart from any market connection, has been increasing. Perhaps this change has been encouraged by the growing social awareness that productivity is the key to plenty in the 20th Century just as trade was the key in centuries past. Erich Zimmermann described his resource studies as a "probing downward" from a "limited section of the cultural superstructure" of society "toward the physical foundation."[19] However, his efforts can also be viewed as an attempt to develop an economics of production broader than that previously developed. However, this classic work is more descriptive than theoretical. More specifically, Leontief introduced a new method of analyzing the many linkages in the productive process, input-output analysis. Isard and others have applied this approach to *areas* as well as industries. Western Europeans, struggling for survival in a bi-polar economic world, have produced many studies of productivity. This increased concern for production and productivity has many implications for traditional economic thinking. Recently, Robert Solo has called for a "new direction for economic inquiry," a "true economics of production analyzing the utilization of resources and probing the mysteries of productivity."[20]

The Broadening of Economic Geography

Economic geography also has broadened, from the narrow mercantile geography of the 19th Century to the complex clustering of related specialties described by Murphy as the "fields of economic geography." As with economics, the increasing complexity of the urban-industrial world has encouraged this transformation. Economic geography has continued to stress primary production, but more broadly conceived and balanced by studies of manufacturing, transportation, marketing, ports and hinterlands, urban geography, and even recreation. Recent geographic studies of the journey-to-work[21] and of employment may herald a new geography of labor. A recent paper combines the study of primary production, manufacturing, marketing, and transportation through the geographic study of industrial corporate structure, introducing the spatial dimension into the analysis of the firm.[22] Several geographers have shown interest in the development of a geography of capital and investment, analogous to economic studies of banking, capital formation, and money flows. Concurrently with these changes, economic geography has become less oriented toward the natural world and more oriented toward the social world. Pre-

[19] Erich W. Zimmermann: *World Resources and Industries*, rev. ed., New York, 1951, p. xi.

[20] Robert Solo, *op. cit.*, p. 136.

[21] Robert E. Dickinson: "The Geography of Commuting: The Netherlands and Belgium," *Geogr. Rev.*, Vol. 47, 1957, pp. 521–538.

[22] Robert B. McNee: "Functional Geography of the Firm, with an Illustrative Case Study from the Petroleum Industry," *Econ. Geogr.*, Vol. 34, 1958, pp. 321–337.

occupation with the mutual relationships between economic phenomena and the natural environment has declined, a fact much lamented by some geographers. Similarly, economic geographers today are expressing more concern for the social values involved in conservation, regional economic development, and industrial relocation.

Broadening of the field of inquiry has led also to increasing contacts with other social sciences, especially economics. Such contacts have been fostered not only by the increasing overlapping of subject matter with economics but also by the growing interest in developing a unified theoretical structure for economic geography. An important effect of the broadening of the field has been the dramatization of the need for such unifying theory. As Murphy points out, "general economic geography" (has) "ceased to exist as a research specialty, if, indeed, it could ever have been so regarded."[23] Some geographers have turned to economic theory, hoping that the abstract models developed to solve the problems of the economist can be adapted to the problems of the geographer. Waibel,[24] Melamid,[25] Hartshorne, and others, have examined the Thünen model and applied it to various historical and geographical situations. Conclusions on the utility of the model have been rather mixed. Recently Kraus[26] stressed the value of economic location theory in the analysis of regional organization and the concept of economic costs in the analysis of man-land relations.

[23] Murphy, *op. cit.*, p. 242.

[24] Leo Waibel: *Probleme der Landwirtschaftsgeographie*, Breslau, 1933, pp. 47–78.

[25] Alexander Melamid: "Some Applications of Thünen's Model in Regional Analysis of Economic Growth," paper delivered at American Economic Association Meeting, December 27, 1954.

[26] Theodore Kraus: "Wirtschaftgeographie als Geographie und als Wirtschaftswissenschaft," *Die Erde*, Jahrgang 88, Heft 2, 1957, pp. 110–119.

Awareness of the potential value of location theory to economic geography is spreading widely among American geographers, as indicated by the recent article by Ballabon.[27] However, acceptance of the utility of economic location theory in economic geography does not imply that economic geography can be, or should be, fully integrated with economics. On the contrary, Hartshorne has indicated aptly the narrowly specialized viewpoint which the economist brings to geography. As he says, the economist ". . . is apt to think almost exclusively in terms of relative location, considered purely geometrically, and to ignore other variants of areas . . . ."[28] Furthermore, there are many stated and unstated assumptions underlying standard economic theory which limit the direct applicability of such models in geographic research.

Economic geographers seeking a unifying theory have turned also in other directions. Warntz[29] is working from a frame of reference much broader than that of classical economics. He believes geographers should emulate social physics, through reducing geographic problems to basic dimensions expressed mathematically, the most important dimension being distance.

Alternatively, economic geographers continue to seek theoretical principles from a more traditional source in geography, empirical research. For example, the "principles of spatial interchange" developed by Ullman from his specialized studies of commodity flow[30] and Philbrick's "principles of areal or-

[27] Ballabon, *op. cit.*

[28] Richard Hartshorne: "The Nature of Geography," *Assn. of Amer. Geogrs.*, Lancaster, Pa., 1949, p. 421.

[29] William Warntz: "Transportation, Social Physics, and the Law of Refraction," *Prof. Geogr.*, Vol. 9, 1957, pp. 2–7.

[30] Edward L. Ullman: *American Commodity Flow*, Seattle, 1957.

ganization"[31] are steps toward the development of empirically-derived unifying theory in economic geography.

SUMMARY AND CONCLUSIONS

Historically, economic geography and economics have been quite distinct because their central problems have been different. Both fields have their roots in the Age of Trade. Economics became the science of the market place while economic geography became the science of areal differentiation of the production important to trade. This was essentially a complementary relationship. However, industrialization and urbanization brought new social problems. Economic crises and the complexities of the new society have encouraged economists and economic geographers alike to broaden the field of inquiry.

Economics is balancing its spaceless models with others including the spatial variable, its historic market and consumer emphasis with an expanding interest in productivity, its social competence with more technological competence, and its verbal and mathematical abstractions with more empirical observations. Meanwhile, economic geography is balancing its production geography with studies of consumption, marketing, transportation, and many other economic phenomena. A new concern for social values is being added to the historic knowledge of technological and naturalistic conditions. And economic geographers, no longer satisfied with cartographic generalization alone, are reaching out more vigorously than before to develop verbal and mathematical generalizations and principles. Economics and economic geography are drawing together, in spite of their histories of isolation. This is occurring at all levels, in theoretical studies as well as in applied studies. Thus the newly emerging relationship of the two fields is more than merely complementary; it is truly cooperative. Neither the duration nor the depth of this new cooperation can be predicted, but the benefits to both fields will surely be substantial and lasting.

In the unpredictable future, cooperation could lead to an integration of economics and economic geography, perhaps as parts of that elusive larger whole, an integrated and cohesive social science. But for the present, one may conclude that economics is of only limited *direct* utility in solving the central problems of economic geography while it is of great *indirect* value in helping to understand these problems in their broader social setting. Therefore, geographers should not attempt to recast their subject in the mold of economics; neither should they insist on "splendid isolation" within a narrowly conceived "geographic" economic geography. Rather, they should seek to solve the central problems of economic geography in every way the mind can devise, including, for those with the requisite training and interest, economic location models, national income statistics, productivity analyses, or other advances in the field of economics.

ACKNOWLEDGMENTS

The author wishes to express his appreciation to the many geographers and economists who have read and criticized this paper, including especially Drs. James, Johnsrud, McCarty, Melamid, Solo, Villard, Warntz, and Zupnick.

[31] Allen K. Philbrick: "Principles of Areal Functional Organization in Regional Human Geography," *Econ. Geogr.*, Vol. 33, 1957, pp. 299–336.

THE GEOGRAPHICAL PATTERN OF IRANIAN OIL DEVELOPMENT

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SINCE the beginning of commercial petroleum production, in 1859, oil producing regions have developed in a large variety of patterns. Some regions were fully exploited soon after initial discovery of oil; others were developed slowly over a period of years; sometimes development was interrupted for years before further exploitation took place. In addition there existed at all times a number of regions where oil had been discovered but no development took place. Unfortunately, none of the available data on demand for oil or costs of production explain the differences in the development patterns of the various oil regions.[1] Despite this lack of information, geographical analysis of distribution patterns has been used to discover location and development patterns of petroleum refining.[2] A similar analysis using historical perspectives can be applied in an investigation of regional oil production to discern the patterns of oil development. For a case study of regional oil development patterns Iran, formerly called Persia, was selected. Here large-scale oil production has been carried on in several fields for more years than in any other economically undeveloped region. An investigation of Iranian oil development, therefore, permits observations both on the cumulative effect of many years of oil production, and on the effect of changing techniques, especially in transportation. Due to the long period of oil production in Iran, local urban and rural developments, as well as their political repercussions, can also be considered in evaluating the factors contributing to regional economic growth. The resulting observations on the geographical patterns of oil development in Iran can then be compared with information from other oil producing regions, especially from economically developed countries like the United States, in order to arrive at some conclusions regarding the determinants of regional oil development.

Stage I: Barges and Mules, 1901–1923

Oil development in Iran began in 1901, when the Australian William Knox D'Arcy obtained a concession covering the whole country except the provinces bordering on Russia. D'Arcy had no satisfactory geological records to guide him; however, he knew of several oil seepages within his concession area. Most of these seepages were located within the western foothills of the

[1] J. S. Bain: *Economics of the Pacific Coast Petroleum Industry*, Berkeley, Calif., 1944; also various U. S. Congressional Committees of Enquiry.

[2] Alexander Melamid: "Geographical Distribution of Refining Capacities; A Study of the European Refining Program," *Econ. Geogr.*, Vol. 31, 1955, pp. 168–178.

FIG. 1. Chiah Surkh, Naft-i-Shah, Kermanshah.

Zagros Range. These mountains form an effective barrier between the area of the Persian Gulf and the Mesopotamian plains, the part of the country usually referred to as southwest Iran, and the remainder of the state. Because of this difficulty of access neither D'Arcy nor any of his successor companies have ever searched for oil east of the Zagros Range.

D'Arcy decided to drill first near the well-known seepages of Chiah Surkh located close to the main route from Baghdad to Teheran. Nearly all supplies for this venture had to be imported from overseas through what was then Turkish territory (now Iraq). These supplies were brought by ocean-going vessels to Basra and from there by river steamers to Baghdad. Wagon carriage was required for the last hundred miles from Baghdad to the drilling site. Oil was discovered in two wells in 1903 and 1904; however, the quantities (25 b/d per well) were not considered sufficient to warrant the establishment of regular transportation routes connecting Chiah Surkh to either Baghdad or the Persian Gulf. The fact that all traffic to and from Chiah Surkh would have had to pass through the territory of another state was regarded as a serious obstacle to the development of this oil area, and, in the absence of any local demand, work was abandoned at this site.

For all these reasons D'Arcy decided to transfer the search for oil to the then less well-known Iranian province of Khuzistan, formerly called Arabistan because of its predominantly Arabic-speaking inhabitants. Here transportation on the river Karun passes entirely through Iranian territory from ports on the Shatt-el-Arab to the foothills of the Zagros Mountains. Steamer transportation had been established in 1887, and most seepages could be reached by a few days' mule or camel travel from landing stages on the river above Ahwaz. A site near Ram Hormuz, which contained the best known seepage of the province, was selected for the first attempts to find oil. After drilling several dry holes D'Arcy was almost ready to abandon the whole concession, but decided to try at another less well-known seepage at Masjid-i-Sulaiman.[3] Here D'Arcy finally struck oil in 1908. The quantities of oil discovered (averages per well later exceeded 2000 b/d) were sufficient to warrant establishment of a transportation system both for the import of supplies and the export of oil. Drilling in the area continued, and 14 wells had been brought in by the time outward transportation of oil, and thus commercial production, commenced in 1912 (Tables I and II).

[3] Originally known as Maidan-i-Naftun. The site is located near the ruins of an ancient temple of fire-worshippers, and its name Masjid-i-Sulaiman (Temple of Solomon) was subsequently given to the oil field. This temple probably contained no burning seepages, but offered a magnificent view of one or more burning seepages in a near-by valley. Today the temple offers a similar view, for gas produced together with oil is burnt off in giant flares in the same valley. For a geological description see "Oil and Gas in South-West Iran" in *Simposium Sobre Yacimientos de Petroleo y Gas*, XX Congreso Geologice Internacional, Mexico, 1956.

TABLE I

IRANIAN OIL PRODUCTION, AVERAGE DAILY RATE IN THOUSANDS OF BARRELS

(Including Naft-i-Shah)

1912	2.5	1936	171.4
1913	5.1	1937	213.2
1914	8.0	1938	214.7
1915	9.9	1939	214.1
1916	12.2	1940	180.9
1917	19.6	1941	139.0
1918	23.6	1942	208.2
1919	27.8	1943	208.2
1920	33.4	1944	278.7
1921	45.7	1945	352.0
1922	61.0	1946	400.0
1923	69.1	1947	472.0
1924	88.5	1948	551.0
1925	96.0	1949	598.0
1926	98.2	1950	718.0
1927	108.7	1951	650.0
1928	118.7	(based on first six months	
1929	115.5	production.)	
1930	125.6	1952	21.0
1931	121.6	1953	26.0
1932	135.2	1954	39.0
1933	149.0	1955	326.0
1934	158.5	1956	538.0
1935	156.9	1957	716.0

Source: American Petroleum Institute.

This oil was discovered in a broken uncultivable waste land only utilized for rough grazing by nomadic Bakhtiari tribesmen. Practically all supplies, including food, had to be imported from overseas. Even the plains of Khuzistan with their many rivers[4] could contribute little to the feeding of oil workers. Ocean-going vessels brought cargoes to Khorramshahr (formerly Mommerah) at the junction of the Karun and the Shatt-el-Arab. From there, barges with capacities up to 300 tons carried supplies 114 miles up the Karun to Ahwaz, where a portage of about one mile around rapids in the river was necessary. Goods were transferred by mule-drawn wagons, later replaced by a narrow-gauge railroad. Smaller barges (capacities to 200 tons) continued the journey another 90 miles to Dar-i-Kazina, a river port on the Abri-Gargar branch of the Karun which here approaches nearest to Masjid-i-Sulaiman. From Dar-i-Kazina (elev. 140′) supplies had to be transported another 35 miles up and down rugged hills (maximum road elevation 1317′, followed by a drop to 600′) by mule-drawn Studebaker wagons to the oil field which has an average elevation of 1000 feet. Usually four mules pulled a wagon, but for heavy loads of drilling equipment, etc., a team of 16 mules was frequently necessary. The wagon journey took two days, and night travel was preferred to escape the high temperatures prevailing most of the year (Table III). At a half-way station the wagon wheels had to be removed and soaked in water to restore their shape. A shortage of equipment during and after World War I delayed until 1923 the replacement of wagon transportation by a 2½-foot gauge railroad. Water for human consumption and industry was obtained from local rivers. Supplies were highly unsatisfactory until a difficult 12-mile long pipe line was laid to the upper Karun, which flows here in an unnavigable deep gorge.[5]

The transportation of oil required construction of a 135-mile long pipe line to the Shatt-el-Arab, which took four years to build. The pipe line was located as close as possible to landing stages on the Karun River to facilitate delivery of construction material; but due to the salinity of the soil and the resulting corrosion problems, the pipe line could not, as usual, be buried and had to be placed on supports above ground. As the pipe line ascends from

[4] The plains are largely covered by saline soils, and most river water is unsuitable for irrigation except for date gardens. Salinity of soils, rather than shortage of rainfall, appears to be the cause of absence of cultivation in the upper part of the Khuzistan plains. Despite a recent expansion of agricultural activities, Khuzistan is still a food deficit region.

[5] After the winter rains the level of the Karun rises here up to 45 feet above the low water stage. To insure good water supplies the intake of the pipe line had to be placed on a trolley, running on a concreted railroad bed, that could move up and down according to the level of the Karun.

TABLE II

IRANIAN OIL INDUSTRY: DISCOVERY, PRODUCTION, AND EMPLOYMENT[a]

Area	*Date of discovery*	*Production began*	*Oil producing area in sq. miles*	*Production per day in barrels 1957*	*Employment 1957*
Masjid-i-Sulaiman	1908	1912	54	41,000	5,651
Haft Kel	1928	1928	45	120,000	872
Gach Saran	1928	1940	60	48,000	692
Naft Safid	1934	1945	30	46,000	812
Agha Jari	1937	1945	40	450,000	3,327
Lali	1938	1948	10	11,000	642
Abadan	....	1913	..	314,000[b]	27,435
Ahwaz	....	....	..	.....	2,500
Bandar Mashur	....	....	..	.....	2,356
Other Areas	....	....	..	.....	948
Total				1,030,000[c]	45,235[d]

[a] Naft-i-Shah excluded because of lack of recent information.
[b] Refinery throughput.
[c] Naft-i-Shah produced an estimated additional 2600 b/d.
[d] Includes 510 overseas staff.

Data according to "Oil and Gas in South-West Iran" in *Simposium Sobre Yacimentos de Petrole Y Gas*, XX Congreso Geologico Internaticional, Mexico, 1956; and *Review of 1957*, by Iranian Oil Exploration and Producing Company and Iranian Refining Company, Teheran, 1958.

618 feet to 1366 feet and then drops to about 400 feet within eight miles from Masjid-i-Sulaiman before descending gradually to sea level, four pumping stations had to be built en route.

On the Shatt-el-Arab a pipe line and tanker terminal, as well as a refinery, were constructed on a large, then virtually uninhabited, island south of Khorramshahr using a site of one square mile (today enlarged to five square miles). Due to a slight bend in the Shatt-el-Arab near this site, deep water is found close to the shore, and short jetties permit vessels up to 20,000 tons to lie alongside. The site is also safe from inundation even by the highest tides on the Shatt-el-Arab, and sufficiently firm to support heavy structures without excessive artificial foundations.[6] No other area so close to the Persian Gulf and navigable water offers these advantages. The site with its installations, its residential areas for employees, and other near-by settlements that grew up under the impact of oil development, as well as the whole island, have since become known as Abadan.[7] To supply its employees with fresh milk and vegetables the concessionaire also established farms at Abadan and Dar-i-Kazina.

This geographical pattern of development consisting of one oil field supplied from ocean terminals by river transportation and a minimum of land transportation persisted until 1928. Before construction of the railroad from Dar-i-Kazina a regular journey from Abadan or Khorramshahr to Masjid-i-Sulaiman took five days, although horsemen relying on frequent change of animals could make the trip in 48 hours. The railroad reduced travel by about a day. Telegrams to destinations outside the province necessitated a day's horseback ride from Masjid-i-Sulaiman, or a

[6] The much heavier modern refining equipment requires extensive foundations. The site was not inundated by the 1938 tidal floods, which covered most of the 104 square miles of the island.

[7] The name appears to have developed from Obadan, meaning land of Obad. According to local historians, Obad, a follower of the Caliph Othman, was granted the ownership of the island during the seventh century A.D. A shrine on the island commemorates Obad. Other local experts maintain that the name is derived from the Arabic word for "nowhere," which describes the economic status of the island before the beginning of oil development.

TABLE III

SUMMARY OF CLIMATIC DATA, IN DEGREES FAHRENHEIT AND INCHES OF RAINFALL

Location	*January average*	*July/August average*	*Rainfall average*	*Comment*
Abadan	53	97	7.6	Complete record
Masjid-i-Sulaiman	49	97	8–27	Incomplete record; summer night temperatures remain high
Gach Saran	49	88	8–29	Very incomplete record

three days' ride from Abadan to the office of the Indo-European Telegraph Company at Shushtar, which offered regular communications with some other parts of Iran, as well as with Europe and India. After 1911, local telegraph lines built by the concessionaire made internal and international communications much easier. Despite these many changes in the province, the way of life of the local population remained virtually unchanged during these early years of oil development.

The establishment of this oil field, with its transportation system and other services built and ready before the first drop of oil could be sold, required a huge capital fund. No similar private development of such a difficult region had ever before been undertaken, and the concessionaire failed to obtain the necessary capital in the London financial market, then the largest in the world. The British Government, to secure fuel oil supplies for its navy, took the then revolutionary step of participating financially in this oil venture, which otherwise the concessionaire would not have been able to carry out at that time.[8] Thus for reasons ultimately closely related to geography, the British government became a partner in a concession in a foreign country, which subsequently had important political repercussions.

The relation of geography and politics is also evident in internal Iranian affairs. After many border wars with Turkey, Khuzistan was definitely allotted to Iran in the Treaty of Erzerum of 1847. However, communications across the Zagros remained poor, and until about the middle of the 1920's a trip by horse or coach from Abadan or Khorramshahr to Teheran took nearly four weeks, or longer than a sea voyage to London. Local authorities, usually hereditary sheikhs, were, therefore, nearly completely independent of the Iranian central government. For example, the Sheikh of Mommerah, who ruled over most of the lowlands of the province, had "an autonomy as pronounced as was that of the Sheikh of Kuwait beyond the river (Shatt-el-Arab) in his relations with the Ottomans (the rulers of Turkey)."[9] Although D'Arcy had obtained a valid concession from the Iranian Government, additional local political agreements were necessary.

The co-operation of tribal chiefs had to be obtained to permit access and drilling at Masjid-i-Sulaiman, and similarly pipe line wayleaves and rights to the site of Abadan had to be arranged with the Sheikh of Mommerah. The latter foresaw that this development in

[8] Beginning in 1905 through the Burma Oil Company. Parliamentary consent for this participation was not given until six days before the outbreak of war in 1914. Due to these participations the concessionaire changed its corporate structure and name in 1909 to Anglo-Persian Oil Company, changed in 1935 to Anglo-Iranian Oil Company (renamed British Petroleum Company after nationalization of the Iranian properties in 1951).

[9] Sir Olaf Caroe: *Wells of Power*, London, 1951, p. 28.

FIG. 2.

his territory "would ultimately overshadow all other commercial and other interests and would inevitably cause the Persian (Iranian) government to seek to extend their administration, hitherto delegated to him, to every part of Arabistan (Khuzistan)."[10] Before granting the pipe line wayleaves and the site of Abadan the Sheikh, therefore, insisted on receiving from the concessionaire and the British government a guaranty that they would uphold his "hereditary and customary rights." ". . . Such assurances" (see footnote 10) were given by a representative of the British government, then not yet an official stockholder in the concession company.

As there was no Iranian police in the province, the Sheikh of Mommerah and some tribal chiefs provided security guards for the concessionaire's camps and installations. This was not sufficient, for dissident tribesmen continued to harass camps and transports. The concessionaire, therefore, obtained permission from the Iranian government to import regular troops from British India to protect his employees and property.

[10] Sir Arnold Wilson: *S.W. Persia, A Political Officer's Diary, 1907–1914*, New York, 1941, p. 93.

FIG. 3.

The geographical separation of Khuzistan from the remainder of Iran is further illustrated by the circulation of money and origin of immigrant oil workers. Iranian money circulated primarily at Shushtar, the then capital of the province, which was most accessible from other parts of the country. Elsewhere the Indian rupee served as medium of exchange. Only a few Iranians crossed the Zagros range to take up employment in the oil region. Most semi-skilled and skilled workers were recruited in India, which had been connected to Khorramshahr by weekly steamer services since the beginning of the century. Some of the Indian workers had been trained in the oil fields of Burma. Many experienced drillers were drawn from the oil fields of Eastern Europe,[11] which, of all developed oil regions, had the best then available transportation link (steamer from southern Europe) to Khuzistan. Despite a relatively short land route to the Caucasian oil fields, efforts to obtain skilled workers there from among the local Iranians or Armenians failed completely.

Oil development in Khuzistan also

[11] Galicia, Rumania. The origin of these specialists is remembered in one geographical name, the "Poland" sector of Masjid-i-Sulaiman.

had significant repercussions on the political boundaries of Iran. The treaty of Erzerum had located the boundary on the Iranian shore of the Shatt-el-Arab. The few small vessels (up to about 4000 tons) calling at Khorramshahr before the beginning of oil development were able to anchor in Iranian waters by lying in the mouth of the Karun. Once oil development began, this anchorage was not big enough to harbor the larger ships (to 20,000 tons today) delivering supplies for petroleum development and operations. To avoid anchorage in foreign waters a shift of the boundary was arranged in 1914. The boundary now lies in the middle of the Shatt-el-Arab from a point about one mile below the mouth of the Karun to a point about four miles above it. In exchange, Iran ceded Chiah Surkh and other territory farther north, which according to then prevailing opinions could not be developed economically as part of Iran.[12] Loading of tankers at Abadan commenced in 1912, but no similar boundary arrangements were made here, and ships continue to anchor outside Iranian waters.

STAGE II: THE IMPACT OF THE AUTOMOBILE: 1923–1938

Although a motor car first appeared on the streets of Ahwaz in 1912, automotive transportation did not come into general use in Khuzistan until about 1923. Gradually, a system of motorable roads developed throughout the province. Until recently, most of these roads were unusable during and after the short winter rains. By 1926 it became possible to drive in eight hours from Abadan and Khorramshahr to Masjid-i-Sulaiman on nearly every day of the year; however, supplies continued to be moved almost exclusively over the much slower river-rail system. Simultaneously, the growing consumption of petroleum products throughout the world caused a marked increase in the demand for Iranian oil. Geologists foresaw that the output of Masjid-i-Sulaiman would soon no longer suffice to cover this demand. Indeed, this oil field reached its peak production (118,000 b/d) in 1928, and its output declined thereafter (41,000 b/d in 1957). Other fields had to be discovered to maintain or enlarge Iran's share of world markets. Automotive transportation, now available, was used in this search for oil, formerly limited to sites accessible by mule from the Karun River. Better geological information also encouraged looking in areas without oil seepages.

After several failures an oil field was discovered in 1928 at Haft Kel, about 35 miles south of Masjid-i-Sulaiman. This site, at the edge of the foothills of the Zagros, was selected for drilling after a geological survey assisted by automotive transportation had disclosed that the geological structure of Ram Hormuz extended to this area. Haft Kel was rapidly developed with the help of road transportation from Ahwaz and Masjid-i-Sulaiman, and a 60-mile pipe line was built to feed its oil near Ahwaz into the Masjid-i-Sulaiman/Abadan system. Proximity to the existing transportation system and low relief as well as automotive transport made it possible to commence commercial production at an initial rate of 5000 b/d within a year from discovery of this oil field. No other major oil field in the Middle East started commercial production in so short a time after initial discovery. In a few years the yield of Haft Kel surpassed that of Masjid-i-Sulaiman, and

[12] The then concessionaire retained his rights in the transferred territories, and subsequently developed there the Naft Khana oil field. This field supplies central Iraq, and its development took place entirely through the territory of this state.

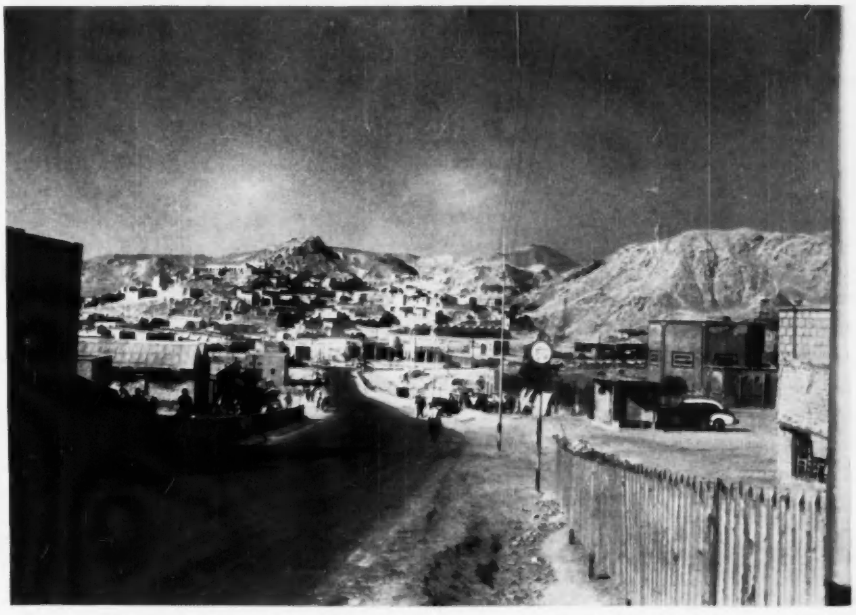

FIG. 4. The upper Karun gorge with intake of the water pipe line for Masjid-i-Sulaiman. Tribesmen crossing the river on rafts. (Courtesy of National Iranian Oil Company.)

FIG. 5. Masjid-i-Sulaiman near first well and main office district. (Courtesy of National Iranian Oil Company.)

its present cumulative production is the highest of any Iranian oil field.

To promote a possible southeastward extension of oil production a motorable track was built in 1928 from Ganoweh on the Persian Gulf to the seepages of Gach Saran, far in the foothills of the Zagros. This road, colloquially known as "the Golden Staircase," passes through very rugged country (an eroded anticline consisting partly of unstable mudrocks), and its use for oil development would have been impossible before the advent of reliable automotive transportation. Large quantities of oil were discovered at Gach Saran in that year (the discovery well on a later test yielded 26,000 b/d), but no arrangements were made to develop this new oil field. Altogether, commercial development during this period was limited to the vicinity of the existing river-rail-pipe line artery. The continuation of this past geographical pattern of oil development into the era of automotive transportation must be attributed largely to the impact of the world-wide depression of 1929. The volume of Iranian oil production remained nearly stationary for several years, and it was, therefore, not economical to draw on production from oil fields not connected to the existing transportation system. Thus, the Naft Safid field, discovered in 1934 between Masjid-i-Sulaiman and Haft Kel close to the existing transportation route, was not brought into commercial production. Agha Jari, discovered during the 1937 recession in a faulted anticline adjoining the southeastern Khuzistan plains, also remained undeveloped.

During this period automotive transportation served to facilitate the search for oil and to assist in improving the existing traffic arteries by providing feeder and rapid passenger services, rather than to change the geographical pattern of oil development. Automotive equipment also permitted the rapid repair or duplication of pipe lines, for example of the water pipe line from the upper Karun to Masjid-i-Sulaiman.[13] More powerful engines permitted the number of pumping stations on the pipe line to Abadan to be reduced to three, despite an increase in the volume of oil transported. To supply Masjid-i-Sulaiman and its vicinity with petroleum products a small refinery was erected within the oil field. The refinery at Abadan was enlarged substantially and new refining processes were introduced. Facilities for employees, for example medical services, were also extended. The better communication facilities within the province encouraged the local population to respond to the economic opportunities offered in the areas of oil operations. Shops (bazaars) were opened, and services, e.g., laundries, cafes, garages, and transport contracting, began to be developed. Although much additional food had to be imported, agricultural activities also benefited from this growth of the local economy.

Simultaneously the introduction of the motor car had most important political repercussions. By 1926 a motor car journey from Teheran to Khuzistan took about two days. Before then, no ruler of Iran had visited the oil region; now official visits became relatively frequent. Although air transportation became possible about the same time, it was little used during this period. As a result of these changes in transportation, Iranian troops and administrators could be moved quickly to Khuzistan, and local autonomy was soon abolished. The Sheikh of Mommerah

[13] In contrast during World War I repair of a short stretch of pipe line between Ahwaz and Abadan, damaged by dissident tribesmen obeying Turkish orders, took three months.

TABLE IV

ORIGIN (PLACES OF BIRTH) OF IRANIAN OIL INDUSTRY EMPLOYEES, 1956

A. Oil fields (excluding Gach Saran and Naft-i-Shah):	
Born in Khuzistan	61.3%
Born in adjoining provinces*	33.5%
Born elsewhere in Iran	5.2%
	100.0%
B. Abadan:	
Born in Khuzistan	39.4%
Born in adjoining provinces*	48.0%
Born elsewhere in Iran	12.6%
	100.0%

*Defined as Isphahan and Shiraz.
Source: Employment data available in Abadan.

who "sought to play a hand against his suzerain beyond the means at his disposal"[14] was deposed and his property confiscated despite British protests. Thus in Abadan and throughout western Khuzistan the Iranian government became both sovereign and landlord. In the oil fields local rule was similarly abolished. But motor cars cannot so easily reach most tribal territories, and Iranian government rule over the foothills of the Zagros did not become so absolute as in the plains.

The establishment of cheap omnibus transportation throughout Iran substantially increased the flow of semi-skilled and skilled workers to the oil region. Indian workers were gradually replaced by Iranians. But despite the available new means of transportation, geographical factors determine to this day the origin of Iranian workers from beyond the Zagros Range. Employees born in the provinces adjacent to Khuzistan outnumber all other immigrants to the region (Table IV). Marriages between immigrant Iranian workers and local women increased the ties between Khuzistan and Iran, and thus eased opposition to political changes within the province.[15] These political, economic, and social changes enabled the Iranian government to force through a substantial revision of the concession terms in 1932 (after League of Nations mediation because of British government involvement). These revisions resulted in an increase of revenues for Iran and a diminution of the concession area. The latter was generally limited to the accessible area south and west of the main Zagros range. A few years later the Iranian government requested a shift of the boundary on the Shatt-el-Arab near Abadan, similar to the change made at Khorramshahr in 1914. Agreement with Iraq to locate the boundary in the thalweg for about four miles opposite Abadan was reached in 1937. In return Iran promised financial contributions to the dredging of the Shatt-el-Arab. As no payments were made by Iran, this agreement was never implemented. The assertion of full Iranian sovereignty over Khuzistan still left oil transportation and ancillary activities on the Shatt-el-Arab beyond the control of the Iranian government. For example, rent to anchor a floating dock at Abadan has to be paid to Iraq.

The new means of communication also increased the demand for petroleum products throughout Iran. Since the Khuzistan oil fields and refineries are located far from the main centers of Iranian oil consumption (Teheran, Hamadan, Tabris) an oil field near Chiah Surkh was developed. This field, subsequently called Naft-i-Shah in Iran, straddles the 1914 border. Oil had been discovered in its Iraqi sector[16] in 1923, and the extension into Iran was proven in 1932. As this field is also located

[14] Caroe, *op. cit.*, p. 29.

[15] By tying poor local families to relatively rich immigrant oil workers. According to several competent observers, the practice of polygamy has been very significant in assisting the political integration of Khuzistan into Iran, for one immigrant can thereby establish ties with several local families.

[16] Called Naft Khana. This oil field supplies a refinery at Alwand near Chiah Surkh.

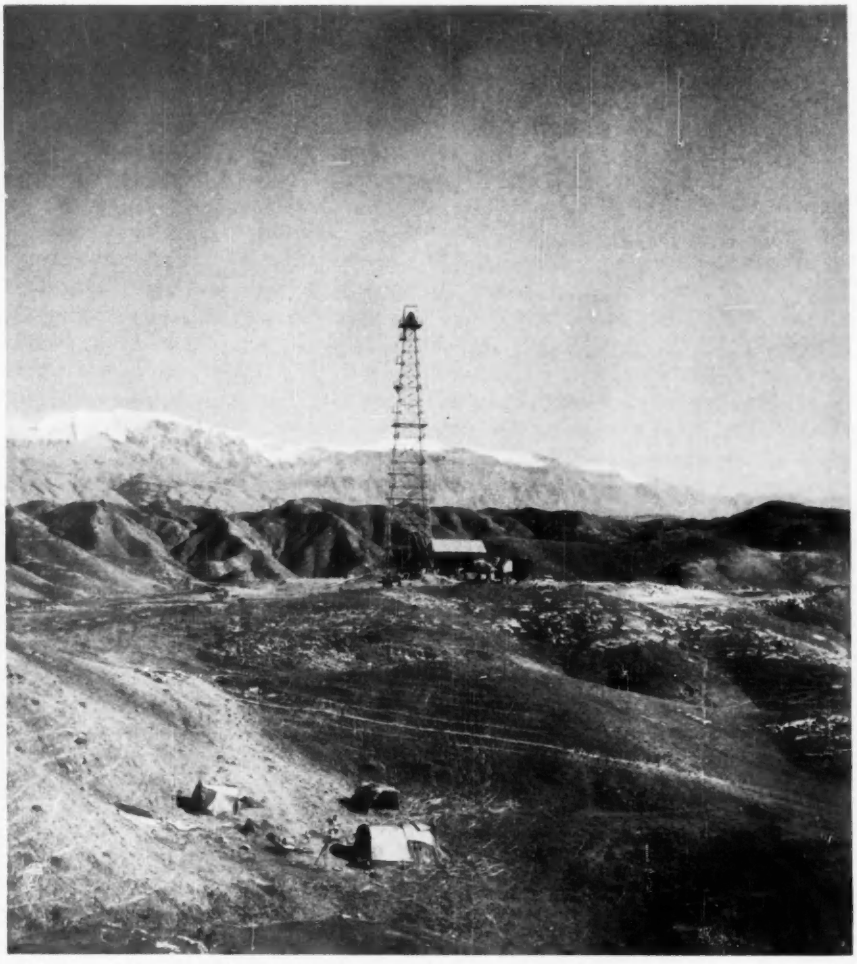

FIG. 6. Gach Saran oil well with tribal tents in foreground. (Courtesy of National Iranian Oil Company.)

west of the Zagros Range (elev. under 1000 feet), its oil is partly refined on the spot, and the heavier, less pumpable portions are removed. These fractions are recycled into the ground to maintain pressures in the oilbearing strata.[17] The lighter and viscous portions are pumped in a three inch pipe line 101 miles across a branch of the Zagros Range (maximum pipe line elevation 6400′) to Kermanshah (elev. 4200′). Here a small refinery (capacity 3600 b/d) was built, whose products are transported by road across the main Zagros Range (maximum road elevation about 8000′) to Hamadan (elev. 5600′) and inland points beyond. Supplies for this oil field and its refineries, which

[17] Unwanted fractions were also recycled into the ground at Masjid-i-Sulaiman and Haft Kel during the depression and World War II.

commenced commercial production in 1935, were imported mainly by river route through Iraq. Despite the significance of automotive transportation, the development of Naft-i-Shah does not depart from the geographical pattern observed in Khuzistan.

STAGE III: THE TRANS-IRANIAN RAILROAD AND SOUTHEASTERN EXPANSION, 1938–1954

Access from Khuzistan to the remainder of Iran was further improved by the completion of the Trans-Iranian Railroad in 1938. This line connects Bandar Shapur, a new port on Khor Musa, a tidal inlet of the Persian Gulf, with Ahwaz, Teheran, and the Caspian Sea bypassing most of Iran's major industrial towns. For economic reasons most experts suggested a different alignment connecting other towns, as well as possibly Russian and Turkish railroads with an established port farther east, for example Bushire or Bandar Abbas. However, primarily political reasons were decisive in selecting this very difficult route to Khuzistan. Similar political reasons appear to have determined the costly construction of the new port of Bandar Shapur on swampy unstable land, rather than the expansion of the existing port at Khorramshahr.[18] Despite the political character of the railroad route, the availability of the new route as well as the new port had significant repercussions on the geographical pattern of subsequent oil development in Iran.

For some time past, plans had been made for the development of Gach Saran and Agha Jari. These plans were advanced further in 1938–1939 by an enquiry into the possible establishment of another tanker and pipe line terminal, together with a refinery on Khor Musa near Bandar Shapur. Construction of a new "Abadan" on Khor Musa was believed to be economical in view of the distances from the southeastern oil fields to the existing terminals (Agha Jari 96 miles; Gach Saran 110 miles), and difficulties in the transportation of the relatively heavy oil from Agha Jari. The inquiry disclosed that Khor Musa with the bar at its mouth has a minimum depth of 38 feet at high tide (24′ at low tide), with a minimum width of 240 yards at this depth. Very little silt was found to be depositing there, and a little dredging would permit passage of loaded tankers up to 40,000 tons dead weight.

A site on deep water about seven miles further up the inlet than Bandar Shapur was found to be suitable for the construction of landing jetties. The low ground and high tides (highest spring tides 20′, average neaps 12′) would necessitate extensive embanking (25′ high) for the service area adjacent to the jetties. Land suitable for refinery construction and housing areas was available about three and a half miles inland. A further three miles inland lies the only village in the vicinity from which labor for the early stages of construction could be drawn. The necessary quantities of fresh water would be available from the river Jarrahi, about 18 miles distant. After treatment this water is suitable for domestic consumption; however, industrial installations using it would require frequent cleaning. Rocks for the building of embankments and foundations would have to be obtained from the Suweira quarries, about 35 miles away.

[18] During World War II the port of Khorramshahr was also expanded. A further expansion is now taking place, and both Khorramshahr and Bandar Shapur are now used as ports by the Trans-Iranian Railroad System. During World War II a 35 mile long branch of the railroad was built to Basrah. Due to the small volume of traffic on this branch line after the end of World War II, this extension was dismantled.

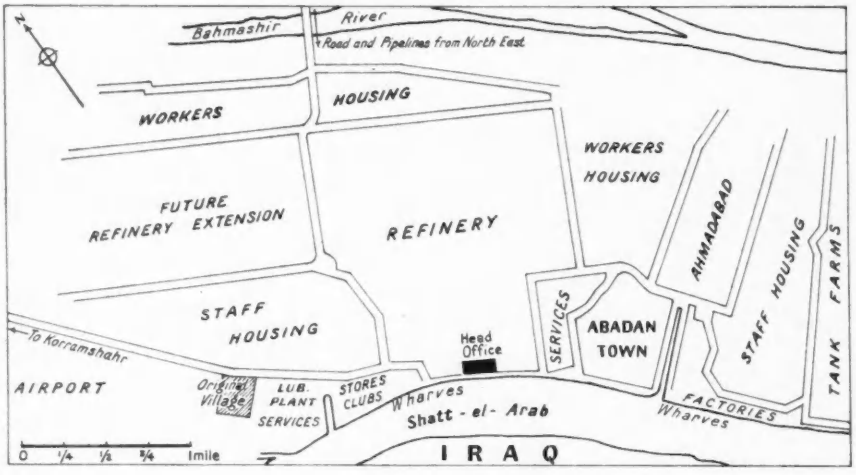

FIG. 7. Abadan.

The outbreak of war in Europe in 1939 prevented the immediate execution of this plan, as well as the associated development of Agha Jari. The market for Iranian oil shrank considerably, and the planned development of Naft Safid, as well as that of the Lali oil field discovered in 1938 forty miles north of Masjid-i-Sulaiman, was abandoned, despite the proximity of both fields to existing arteries of transportation. Commercial production at Gach Saran (elev. 2500–3000 feet), which had commenced in 1940 after completion of a gravity-flow pipe line to Abadan, was suspended when the fall of France further reduced demand for Iranian oil. Another reason for the suspension was tribal unrest in the southern Zagros area, which placed Gach Saran in a virtual state of siege for part of the war. Despite the new means of transportation available, oil operations during the first years of the war continued to be limited to the geographical area served by the original river-rail-pipe line system.

Russia's entry into the war in 1941 and the subsequent allied occupation of Iran did not change this pattern of operation. Although large quantities of petroleum products from Abadan now moved north to Russia, these deliveries did not offset the reduced exports to Europe. Trans-Iranian transport was severely strained by this heavy traffic to Russia, and to relieve this pressure a 180-mile petroleum product pipe line was built from Abadan via Ahwaz to Andimeshk, at the junction of the Khuzistan plains and the Zagros Mountains. From Andimeshk, petroleum products continued their journey by road or rail tankers. Construction of this pipe line did not enlarge the area of oil operations; however, the influx of foreign troops and military transports into the oil region caused a substantial growth in the local economy, which probably exceeded the effects of over 30 years of oil production.

The battle for control of the Pacific in the last years of the war greatly increased the demand for fuel oil bunkers and aviation gasoline from Iran. Additional quantities of the former were obtained by the development of Agha

Jari, which produces a crude oil that in refining yields a high percentage of fuel oil. To speed the development of Agha Jari the railroad from Dar-i-Kazina to Masjid-i-Sulaiman was dismantled in 1943, and its parts and equipment were used for a 41-mile line across level land from Bandar Shapur to Agha Jari. As at Masjid-i-Sulaiman water had to be obtained from a turbulent stream, a tributary of the Jarrahi, about ten miles away. Housing for all grades of oil workers had to be provided in this until then virtually uninhabited area of rugged relief (elev. 400 to 1400 feet).

Twelve wells were brought in before the completion of a 96-mile pipe line to Abadan permitted the start of commercial production in 1945, with an initial output of 57,000 barrels a day. Since then Agha Jari has become the largest producing field in Iran (450,000 b/d in 1957). Commercial production at Gach Saran was not recommenced. Instead, the last 91 miles of pipe line from this field were used to transport condensate of natural gas from Pazanun to Abadan, where it was transformed into aviation gasoline. For lack of a market this natural gas, discovered in 1937 in an extension of the Agha Jari oil field, had remained unused until then. Neither of these developments could have been carried out so rapidly by relying on road transportation from Abadan or Khorramshahr. Extensive flooding east of the Shatt-el-Arab prevents direct road access from these ports to the southeastern oil fields from about December to July or August. Pipe lines crossing these lowlands are covered by water during this part of the year. Road transport from Ahwaz is hampered by cumbersome ferrying across the Jarrahi at Khalafabad. Unloading supplies at Bandar Shapur and rail transportation to Agha Jari avoided these difficulties, and thereby permitted the rapid enlargement of the area of oil operation.

To increase oil supplies in the final stages of the war, Naft Safid (elev. 800′) was connected to the Masjid-i-Sulaiman-Abadan pipe line (20 miles) in 1945, with an initial rate of 11,400 barrels a day. Like Haft Kel, this field was easily developed by road transport from Ahwaz. Materials for further expansion of Masjid-i-Sulaiman were also delivered by road transport. During this period supplies were shipped to Ahwaz either by trans-Iranian railroad from Bandar Shapur or by barge from Khorramshahr. To satisfy the huge military requirements the capacity of the Abadan refinery was expanded from 240,000 to 500,000 barrels a day, which thus became the largest refinery in the world. Manufacture of barrels and drums for packaged petroleum products supplied directly to the military, as well as specialty petroleum production was also started in Abadan. This slightly diversified the industrial structure of the city, and its population increased to about 150,000.

The end of the war did not reduce the demand for Iranian oil, and the geographical pattern of development reached during the last years was maintained. Minor shifts, however, resulted. Demand for aviation gasoline declined, and operations at Pazanun were discontinued in 1946. The wartime demand for fuel oil was more than replaced by a demand for heavy crude oil from European refineries, and production at Agha Jari was expanded substantially. The project of constructing a new tanker terminal was now carried out, and in 1948 the port of Bandar Mashur on Khor Musa was opened for the sole purpose of delivering Agha Jari crude oil by gravity-flow pipe line to tankers. Due to the growth of refining activities in Europe and other parts of the world, the

plan to build a refinery near this port was not carried out. In 1946 a smaller terminal for the export of crude oil from the northern fields was built at Khosrawabad, 17 miles downstream from Abadan. To boost crude oil production Lali, by relief the most rugged field in Iran, was connected in 1948 to the northern pipe line system at Masjid-i-Sulaiman, 38 miles distant. Lali's output never became large (11,000 b/d in 1957). In 1950 production at Gach Saran recommenced with an output of 42,000 barrels a day.

Use of the trans-Iranian railroad, as well as the relatively limited expansion of the northern oil fields, made it economical for the concessionaire to abandon barge transportation on the Karun in 1950. Except for downstream shipment of gravel or stones to building sites at Abadan and Khorramshahr, and occasional bulk cargoes, traffic on the river ceased. Supplies for the northern oil fields henceforth reached their destination by rail from Bandar Shapur or Khorramshahr to Ahwaz and from there by truck, or all the way from Khorramshahr or Abadan by truck. Dar-i-Kazina and its river port decayed, except for its vegetable and dairy farms. Ahwaz became the transportation and storage center of the oil region, and for a time the concessionaire considered establishing his headquarters there. Other industries (textiles, milling, etc.) were attracted by its facilities, and the population increased from about 30,000 before the construction of the railroad to 120,000 in 1957. Shushtar, formerly head of navigation on the Karun and communication center bypassed by the railroad and oil development, declined from about 28,000 to 15,000 during the same period. Already some years earlier Ahwaz had replaced Shushtar as official capital of Khuzistan. Development in the southeastern oil fields was not affected by the changes in the north.

Beginning in the 1920's aviation slowly began to improve passenger communications between the towns and oil fields of Khuzistan. After the end of the war local airplane traffic increased considerably without affecting geographical distributions within the oil region. Abadan became a major stop on air routes between Europe and South Asia. To some extent this development was encouraged by the low price of aviation gasoline in Iran.

The opening of the trans-Iranian railroad considerably increased the migration of Iranians into the oil region[19] which thereby lost some of its previous non-Iranian population characteristics. These and other developments enabled the Iranian government under Premier Mossadeq to carry out the nationalization of the oil properties in 1951. The ensuing international boycott of Iranian oil resulted in a nearly complete shutdown of oil operations. Naft-i-Shah with its refinery at Kermanshah and parts of the Abadan refinery that supply Iranian consumption remained in production. The output of the northern oil fields of Khuzistan was curtailed to keep the Abadan refinery going at this low level of activity. Agha Jari, producing crude oil for export only, was shut down completely. Production at distant Gach Saran was again suspended, despite the gravity-flow pipe line to Abadan. This cutback of activities during the nationalization crisis, therefore, resulted in a return to the original riverine pattern of oil development, although the Karun was now no longer used for transportation.

[19] During winter the new means of transportation bring to Khuzistan many relatives and friends of immigrants. They are people who want to escape from the intense cold of northern and central Iran. Local authorities estimate this seasonal influx in Abadan to approach 100,000 persons.

STAGE IV: THE IMPACT OF RECENT TRENDS IN THE LOCATION OF REFINERIES—SINCE 1954

Large-scale production recommenced after a new oil agreement had been signed between the Iranian government and a group of foreign oil companies (the so-called International Consortium) in 1954. Naft-i-Shah and Kermanshah were excluded from the agreement as supplying exclusively the Iranian market. Export of Agha Jari crude oil soon recommenced. As after World War II, it again took some time before production at Gach Saran could be resumed in 1956. Due to the considerable growth of refining activities in areas of consumption during the period of nationalization,[20] the Abadan refinery has so far not returned to working at more than 80 per cent of its capacity. The output of the northern fields also has never regained pre-nationalization levels, and exports from Khosrawabad have not been resumed. Despite this reduction of activities the population of Abadan increased to probably 250,000 inhabitants in 1957, and further industrial diversification (petro-chemicals, etc.), is now being considered to alleviate unemployment.

The world-wide trend to locate refineries in areas of consumption has had important repercussions on the size of tankers.[21] Whereas refined products are in general shipped most economically in tankers not exceeding 20,000 tons, the crude oil imported by refineries located in areas of consumption travels cheaper in larger tankers. This trend has, therefore, encouraged the building of larger tankers. Ships exceeding 100,000 tons are now being built, and even larger tankers are economically feasible. Although Bandar Shapur permits the loading of 40,000-ton tankers, this is now not sufficient to enable Iran's oil to compete in foreign markets. No point on the coast of Khuzistan offers facilities for the loading of larger tankers.

Farther east in Fars province this possibility exists, and a plan is now being carried out to connect Gach Saran, believed to be potentially the largest oil field in the world, to a new port near Ganoweh. Pipe lines from Gach Saran (87 miles) can generally follow the road across the Golden Staircase. The elevation of Gach Saran and the underground pressure of the oil will probably suffice to transport it to the coast by gravity-flow pipe line without additional pumping. A site on the coast, 12 miles from Ganoweh, to be called Kuh Bang, offers stable land for the erection of storage tanks and other facilities. Satisfactory fresh water is available from near-by rivers as in Khuzistan, and unskilled labor can be obtained from surrounding villages.[22] For the loading of up to 100,000-ton tankers a 22-mile submarine pipe line will have to be built into the Persian Gulf to the vicinity of Kargh island, which also offers some shelter in storms. Construction material will be delivered to

[20] Alexander Melamid: "Center of Gravity of Domestic Refineries joins Foreign Trend in Slip to Location in Consumer Areas," in *The Oil Forum*, monthly, Fort Worth, June, 1955, pp. 215–218.

[21] Alexander Melamid: "Supertankers and Refinery Locations," *The Oil Forum*, November, 1955, pp. 480–485.

[22] Most maps indicate steppes or deserts in this coastal area. However there are many villages, and during the writer's visit in early June, 1957, cereals grown without the aid of irrigation were being harvested in a 15 mile wide strip between the outer foothills of the Zagros and the sea. Due to a relatively heavy rainfall in the preceding winter (estimated at about 15 inches) cultivation appears to have been more extensive than in normal years. Population densities are undoubtedly much higher than in similar unirrigated portions of Khuzistan. The area regularly exports cereals to Kuwait shipped in dhows from Ganoweh. Depressions within this area contain extensive date gardens.

Ganoweh (pop. 1200) by seagoing barges and a tidal creek there will have to be dredged to a depth of ten feet at low tide (high tide 19′; present depth at low tide 1′). The execution of these plans is estimated to cost about $100,000,000. This development will encourage the movement of Iranian oil operations from the vicinity of the Karun valley to the southeast in continuation of a geographical trend which began during World War II. It poses the question, where should headquarters of oil operations now be located? Previously, Abadan or Masjid-i-Sulaiman, as well as for a time during the early years Khorramshahr, were headquarter towns. The absence of any towns in the southeastern area, the increasing significance of the Iranian central government in oil operations, and reliable aviation and telecommunication services are responsible for new headquarters now being established in Teheran.[23] Due to its elevation and the resulting comfortable climate, as well as its pleasant topography, Gach Saran is to be developed into a health resort for oil industry employees.

LOCAL DEVELOPMENT

Distinct geographical patterns are also exhibited by the settlements that developed simultaneously with the growth of oil production. Masjid-i-Sulaiman and Agha Jari, both developed primarily by railroad transportation, show striking similarities despite significant differences in the dates of their establishment. Supply, storage, and repair facilities are clustered near the railroad terminals built either at the edge or adjoining the area of oil production. In contrast, processing plants were established in central areas of level land within the oil fields. Administrative quarters grew up near the sites of the first wells which were not necessarily the center of later oil operations. Due to its more recent origin, smaller population[24] and greater distance from densely settled territory, no large bazaar center has developed at Agha Jari. Oil fields developed by truck transportation, for example Gach Saran, exhibit a much more dispersed pattern of installations and offices. However, Lali, which is divided by a deep gorge of the Karun River, resembles the railroad-developed oil fields. No bridge across the gorge was built until 1950, and supply, storage, repair, and administrative facilities congregated eccentrically south of the river. Except in cooler Gach Saran, residential sections in all the oil fields tend to occupy ridges to escape the heat. At Masjid-i-Sulaiman, villages established by local tribesmen after oil production began cling to steep sides of valleys, presumably for traditional reasons of defense. In Gach Saran, with its higher rainfall and wide valleys, cereals (rice, wheat, etc.) are cultivated with and without the aid of irrigation. Tribal villages and tent locations predate oil development and have limited relations to the oil economy. Oil workers drawn from the local tribes tend to reside at housing centers developed by the concessionaire.

Abadan developed almost concentrically around the refinery. As in most rapidly growing urban areas, the earliest good residential quarters located up river from the refinery developed into a section containing administration buildings, clubs, and stores. Similarly, the first workers' residential area downstream from the refinery, originally

[23] Connected to Andimeshk and Abadan by a products pipe line operated by the National Iranian Oil Company since 1957.

[24] Due to tribal migrations and other seasonal influx no accurate population data except for direct oil company employment (Table II) are available.

called Sikh Line for the tents of imported Indian workers, developed into a section containing hospitals and other public service institutions. Beyond this area a settlement not controlled by the concessionaire grew up. Known as Abadan Town it contains extensive bazaars, and is separated from the concessionaire's territory by wide boulevards. Public utility services and advice on town planning were given by the concessionaire to Abadan Town and another independent settlement, Ahmadabad, located inland from Abadan Town. Downstream from Abadan Town are located various ancillary plants (slaughterhouses, etc.). Residential areas controlled by the refinery management now completely encircle the independent and industrial areas; they contain five swimming pools and many recreation sites. Nearly throughout its length in Abadan the river is lined with jetties. Upstream wharves generally serve barge traffic. A lubricant blending and drumming plant delivering its products by barges to trans-Iranian railroad terminals for the Iranian market was built close to these wharves.

Without a refinery Bandar Mashur remained a small settlement. Due to the danger of floods residential and administrative areas were established about four miles inland from the jetties. No industries have been attracted. After completion of construction of a road to Bandar Shapur, commutation between the two adjoining ports and bazaar districts may develop. Kuh Bang can be expected to resemble Bandar Mashur, except that residential areas will probably locate close to its splendid beaches.

CONCLUSIONS

Oil production in Iran clearly exhibits the function of various forms of transportation in shaping the geographical pattern of development. Transport of supplies to oil fields appears to be more crucial in forming these patterns than outbound shipments of crude oil. As in most other geographical analyses of the petroleum industry the working of this function of transportation cannot be evaluated in terms of costs.[25] However, the shrinkage of the area of oil operations during past recessions of demand indicates the significance of these costs, for otherwise no such considerable geographical adjustments would have taken place. In the language of the economists, Gach Saran, despite its production potential, must, therefore, be described as a marginal oil field up to the present. Local development, besides exhibiting the usual urban growth phenomena, confirms the function of inbound transportation in shaping geographical patterns.

Other countries exhibit in principle similar patterns. In the United States, river transportation characterized the early stages of development; however, railroads soon caused widespread dispersal. The many means of transportation available in the United States also explain the economical development of low-yielding oil wells there (average output per well 12 b/d; average production per well probably somewhat higher when the fields were first developed), while the resources of Chiah Surkh with twice that yield remain untapped. Geographical patterns of oil development in Mexico, Colombia, Venezuela, Iraq, Burma, and other countries resemble the Iranian pattern more closely. In riverless Saudi Arabia coastal oil fields, easily supplied from ships, were developed before inland fields. The impact of restriction schemes (reduction of permitted production per well) in the United States, however, prevents showing the geographical effect of recessions

[25] See footnote 2.

in demand since the depression of 1929.

The relationship of geography, transportation, oil development, and political status in Iran is also not unique. Throughout the Arabian peninsula political integration is proceeding under the impact of petroleum development.[26] Boundary revisions to accommodate tanker terminals within the oil-producing state are, for example, now desired by Iraq.[27] As in Iran, employment of skilled Indian workers in the Saudi Arabian oil field preceded immigration from the western portions of that state. Reductions in the employment of refineries not located in areas of consumption is attested to in the United States,[28] and could have been expected in Iran even without the repercussions of nationalization. Despite the lack of detailed comparative data, it appears, therefore, that the development of the Iranian oil regions exhibits no unusual geographical patterns or determinants.

[26] Alexander Melamid: "Boundaries and Petroleum Developments in Southern Arabia," in *Geogr. Rev.*, Vol. 47, 1957, pp. 589–591.

[27] Iraq wants to establish a petroleum port at Umm Qasr, as Fao its present port on the Shatt-el-Arab cannot, like Abadan, handle tankers larger than 20,000 tons. Access to Umm Qasr requires passage through territorial waters of Kuwait. So far no agreement has been reached and Iraq is now planning to construct a new oil port on an artificial island in the Persian Gulf.

[28] See footnote 2.

AGRICULTURAL REGIONS OF SOUTHERN ONTARIO* 1880 AND 1951

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THE economic development in Southern Ontario since 1940 has surpassed that of all other regions of Canada. Expanding cities and towns have reduced the area of agricultural land and have increased the demand for agricultural produce. Approximately 20 per cent of the total area of the Palaeozoic lowland[1] (Fig. 2) is now urban land or is occupied by roads, railways, parks, cemeteries, and provincial forests. In parts of the highly industrialized belt along Lake Ontario, the area of agricultural land has declined as much as 20 per cent since 1940. The most rapid urbanization is occurring in the areas with the highest proportion of good quality agricultural land. Land use planning on a regional basis is a prerequisite to future prosperity in this part of Canada.

Basic to an understanding of present agricultural land use patterns is the reconstruction of the agricultural geography of the past. Oftentimes, such an investigation will greatly illuminate the dynamic forces that initiate and give impetus to the changes. The purpose of this paper is to present the agricultural regions of 1880, to study the relation between these and those of 1951, and to explain the changes and to speculate regarding future trends.

In 1880, practically all of the suitable land had been occupied and improved. The acreage in wheat was three times what it was in 1950, though the livestock population was less than 40 per cent of the 1951 figure. The era of diversified and specialized farming had begun while the period of rapid exploitation and increasing farm population was drawing to a close.

The map of the 1880 agricultural regions has been constructed after a careful study of census data, the Ontario Agricultural Commission Report, and all other relevant historical source materials (Fig. 4). Wheat was the dominant cash crop. There was a very large part of Southern Ontario which could be classified as a general or mixed farming region with an emphasis on wheat production. Specialization and diversification was in its infant stages and even in areas where the trend was in this direction, wheat was still one of the most important crops. The traditional procedure in farming prior to 1880 was to clear as quickly as one could as much land as possible, and to grow wheat year after year, until yields or prices declined. This was the pattern everywhere throughout the Palaeozoic lowland on all soil types regardless of their texture, drainage, or inherent capabilities. Wheat was grown on

*This paper was presented at the annual meeting of the Canadian Association of Geographers in Ottawa, June 5, 1957. It is based upon research carried out for a doctoral dissertation, "The Agricultural Geography of Southern Ontario," submitted to the University of Toronto in 1955.

[1] The Palaeozoic lowland is that part of peninsular Ontario to the south and east of the Pre-Cambrian Shield.

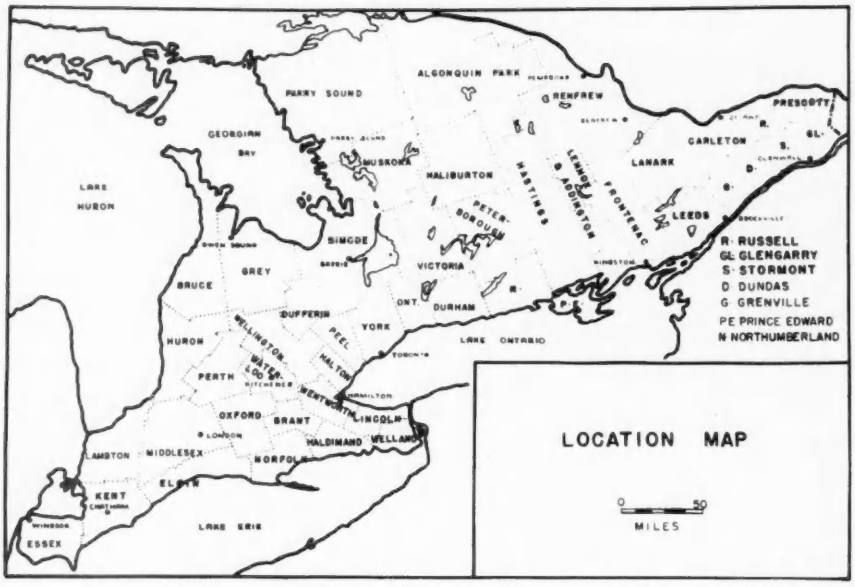
ALGONQUIN PARK
PARRY SOUND
RENFREW
PRESCOTT
GEORGIAN BAY
CARLETON
LANARK
MUSKOKA
HALIBURTON
LAKE HURON
LEEDS
SIMCOE
VICTORIA
BRUCE
GREY
DUFFERIN
ONT.
DURHAM
YORK
PEEL
HURON
PERTH
OXFORD
BRANT
LINCOLN
HALDIMAND
WELLAND
LAMBTON
MIDDLESEX
NORFOLK
ELGIN
KENT
ESSEX
LAKE ERIE
LAKE ONTARIO
R RUSSELL
GL GLENGARRY
S STORMONT
D DUNDAS
G GRENVILLE
PE PRINCE EDWARD
N NORTHUMBERLAND
LOCATION MAP
0 50
MILES

FIG. 1.

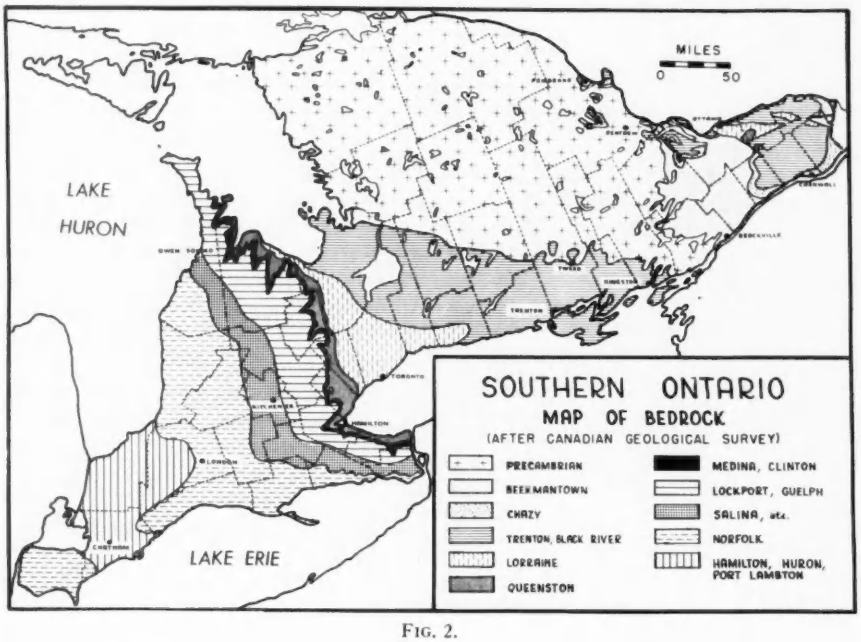
MILES
0 50
LAKE HURON
LAKE ERIE
SOUTHERN ONTARIO
MAP OF BEDROCK
(AFTER CANADIAN GEOLOGICAL SURVEY)
PRECAMBRIAN
BEEKMANTOWN
CHAZY
TRENTON, BLACK RIVER
LORRAINE
QUEENSTON
MEDINA, CLINTON
LOCKPORT, GUELPH
SALINA, etc.
NORFOLK
HAMILTON, HURON, PORT LAMBTON

FIG. 2.

the flat, imperfectly-drained, and acid soils of the clay plains, on the steeply-sloping, light-textured soils of the terminal moraines, on the rolling drumlins with their highly calcareous till soils, and even on the shallow stony land of the limestone plains.[2]

Similarly, with regard to expansion of agricultural settlement generally, physical factors played a very minor role (Fig. 3). All types of land and soil were occupied. Even the Pre-Cambrian upland, with its spotty pockets of good soil and its vast stretches of thin sterile podzols, did not provide a sufficient barrier to preclude its settlement.

For a considerable time, the poor land supported as many people as the good land. Initially, farm depopulation was not generally due to the abandonment of sub-marginal lands nor to the physical deterioration of productive soils. Furthermore, the exodus from the poorer areas did not occur any sooner after settlement than it did in the more productive regions.[3] Thus, one should recognize the importance of tradition and the human factor in the earlier periods of Southern Ontario's agricultural development. Keeping this background in mind, let us examine more closely the 1880 pattern.

TYPES OF FARMING IN 1880

Because of improved transport facilities and markets, livestock was assuming a greater importance, while the increase in urban population was stimulating the development of dairying and market gardening. It is interesting to note, however, that other factors were involved in the early localization of these

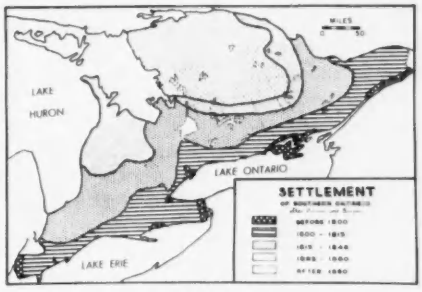

FIG. 3.

types of farming. The holding of fairs was very important in accounting for the initial development of livestock rearing in Western Ontario.[4] Flax was an important cash crop in areas where there was a large population of German origin. The introduction of dairy farming to Oxford County, in the first instance, was due to the fact that a cheesemaker by the name of Harvey Farrington from Herkimer County, New York, visited friends in North Norwich township in 1863.[5] He decided to stay and in the following year erected the first cheese factory there. It is true that the physical conditions were propitious for dairying and that the market for cheese was excellent, but had his friends happened to have resided in another part of Ontario on a similar land type the present land use pattern might have been somewhat different. In Eastern Ontario, the cheese factory system was also introduced at an early date from nearby New York State.

By 1880, the outlines of the corn belt had taken shape. It had been discovered that climate and soils favored corn, wheat, and tobacco production in Kent and Essex Counties, and that local supplies of corn and wheat were advantageous to profitable hog-raising.

Fruit growing was in the experimental

[2] For a map of the physiographic areas of Southern Ontario, see L. J. Chapman and D. P. Putnam: *The Physiography of Southern Ontario*, University of Toronto Press, Toronto, 1951.

[3] See J. W. Watson: "Rural Depopulation in S. W. Ontario," *Annals of Assn. of Amer. Geogrs.*, Vol. 37, 1947, pp. 145–154.

[4] See R. L. Jones: *History of Agriculture in Ontario 1613–1880*, Toronto, 1946, pp. 159–61.

[5] *Ibid.*, p. 254.

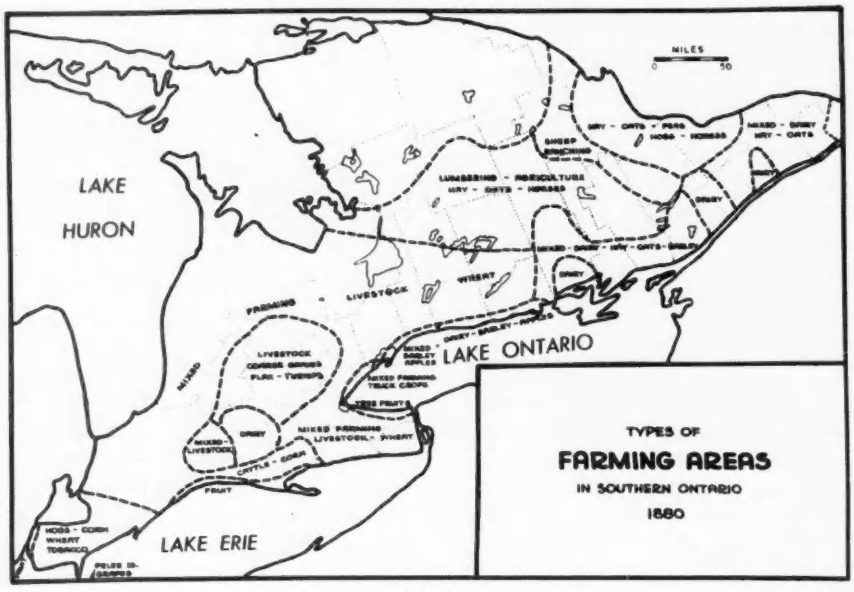

FIG. 4.

stage, as evidenced by the widespread distribution of apples, there being 300,000 acres of small orchards scattered throughout the peninsula. There was also a scattered distribution of pears, plums, and cherries. On the other hand, the areas of specialized fruit growing and market gardening were relatively small and were confined to those sections which had a long growing season, in Essex County and along the shores of Lakes Erie and Ontario (Fig. 8). The commercial production was even more localized, since the bulk of the fruit being marketed came from a small section of the Niagara peninsula.

Higher prices for land in the south and the governmental policy of granting new immigrants free land along colonization roads encouraged the agricultural settlement of the Pre-Cambrian upland. However, even in the initial period of occupance, there were difficulties. As Lower stated so graphically, "Each year, the governmental hen would carefully count her chickens, to see how many the hawks, in the shape of sand and rock, had devoured."[6]

The shanty market was the chief determinant of the type of agricultural production in the Shield and in the Upper Ottawa Valley. Hay, oats, and peas were the important crops with hogs and horses the main types of livestock. The growing of peas in Renfrew County has continued ever since.

Between 1880 and 1951, a much closer adjustment of agricultural production to soil and climatic conditions developed. Production per unit area increased greatly by the application of scientific practices and by mechanization. Many farms were amalgamated or enlarged in response to increased costs of operation resulting from mechanization, higher labor costs, and competition from other industries. Production expanded

[6] A. R. M. Lower: "Settlement and the Forest Frontier in Eastern Canada," in *Canadian Frontiers of Settlement*, Vol. IX, Toronto, 1936.

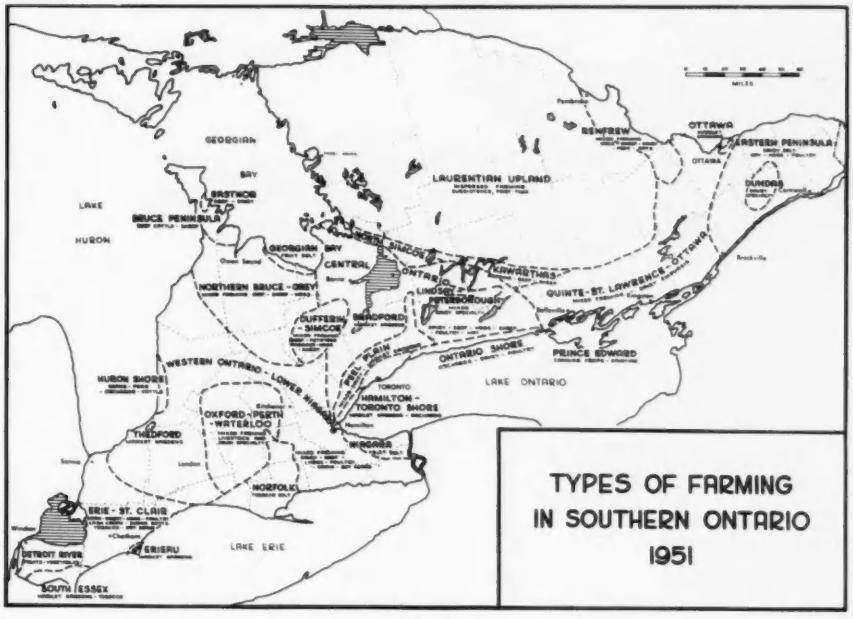

FIG. 5.

in spite of a declining farm area and fewer farm residents. The rural population declined from 78 per cent of the total to 29 per cent between 1880 and 1951, while the actual farm population dropped to 15 per cent by the mid-century.[7]

TYPES OF FARMING IN 1951

The 1951 map shows 29 types of farming areas (Fig. 5). The chief differences in the two patterns include the development of the new tobacco belt in Norfolk and in parts of surrounding counties; the expansion of dairy farming in the Toronto hinterland, in Western Ontario, and in Eastern Ontario; the shift of wheat growing to and the upsurge of cash cropping in the southwest; the change in the center of hog production from the corn belt to the dairy belt; the appearance of the Georgian Bay fruit belt; the growing contrast between the Pre-Cambrian and Palaeozoic areas; the development of bogs for market gardening; the emergence of central Western Ontario as the agricultural heartland; and the drastic decline in agricultural land in the "Golden Horseshoe" area.[8]

The development of the new tobacco belt in Norfolk County was initiated by the increase in demand for cigarettes following 1920. The old tobacco belt of Essex and Kent lacked large areas of light-textured soils essential for the production of the bright flue-cured tobacco. There was a very rapid expansion of production in Norfolk where both climate and soils were suitable.

[7] See *Census of Canada*, Vol. II and Vol. IX, Dominion Bureau of Statistics, Ottawa.

[8] This term has been used to designate a highly industrialized area along Lake Ontario from Oshawa to Niagara Falls where over 25 per cent of the entire Canadian manufacturing production is now concentrated. Professor D. F. Putnam of the University of Toronto has named this area "Mississauga."

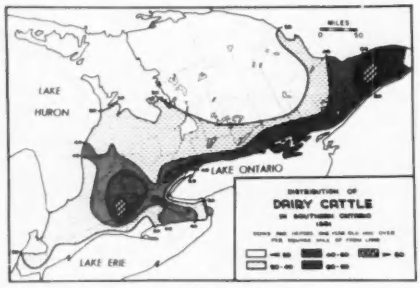

FIG. 6.

This region has the benefit of warm southern slopes and freedom from late spring frosts, though summer moisture deficiency and a tendency to drifting soil are handicaps. The slightly acid deltaic sands of Norfolk, with their open structure, favoring aeration, root penetration, and decomposition of organic material, are highly desirable for tobacco. With increasing prices, the production expanded into the adjoining counties of Elgin, Oxford, and Brant, and more recently to the cooler regions of Simcoe, Dufferin, Durham, and Northumberland, though the acreage in northern areas, in 1951, was less than 5 per cent of that in the Lake Erie counties. The introduction of tobacco growing to Norfolk came at a time when general farming had languished. Depressed areas were restored to an unprecedented prosperity. The value of land increased from $10.00 to $300.00 per acre. The entire pattern of land use and the agricultural landscape were transformed. The large general farms were subdivided. Drying sheds and greenhouses sprung up alongside new farmhouses. New machinery and equipment and new people appeared. Workers came from the "Old Belt," from the United States tobacco-growing regions and from Belgium, Poland, Hungary, Czechoslovakia, and Romania. A more specialized type of farming developed in the "New Belt" since the Fox and Plainfield soil series do not possess the same inherent versatility as the Brookston series of Kent and Essex which can be utilized for general farming and for the production of corn, wheat, canning crops, soybeans, and sugar beets.[9] By 1951, the expansion of tobacco growing in Western Ontario had practically reached its limits while further extension of production in northern areas was dependent upon prevailing prices.

By 1951, dairying was widely distributed throughout the peninsula, though there was increasing specialization in certain locales (Fig. 6). In 1880, there were three districts in Eastern Ontario with some specialization (Fig. 4). The industry was much more widespread in 1951. Winchester and Mountain townships of Dundas County and Russell and Finch townships of the adjoining counties had become the center of highest density of dairy cattle. This area has a higher proportion of productive land than other parts of the Eastern peninsula. For many years, the emphasis was on seasonal cheese manufacturing, but the use of supplementary feeds and the introduction of early-maturing cereals has enabled the farmers on the better lands to carry on a year-around production of milk.

In the Toronto region, the early growth of urban population provided a local market for butter and milk. Toronto's milkshed has expanded with the city's growth. Proximity to the large market is the outstanding control, though the highest densities of dairy cattle are centered in the clay plains (Fig. 6).

The transitional zone between the

[9] For soil maps and description of soil types, see, "Ontario Soil Survey Maps and Reports," published by Canada Department of Agriculture, Ottawa and the Ontario Department of Agriculture, Toronto.

Toronto milkshed and the Eastern cheese belt was, for a time, important for cheese production, but, as transport facilities were improved, the emphasis swung to whole milk and certain areas such as the Lindsay clay plain became specialized in this enterprise.[10]

In Western Ontario, the original core area was Oxford County where the cheese factory system and government creameries had been established at an early date. The undulating till plains with their medium to heavy-textured soils favored production of hay, forage, and grain while the growing season was sufficiently long to encourage the earlier advent of winter production. The 20th century has been marked by a great expansion of the dairy belt to meet the growing demands of the local cities and towns for fluid milk. The direction of this expansion has been westward and northward. These areas have similar land types which were capable of exploitation for this type of farming while competition from cash crops has limited expansion southwards.

The dairy belt and adjoining areas of the Central upland of Western Ontario has emerged as the "Iowa of Canada."[11] Part of this region had more than 150 animal units per square mile of farm land in 1951[12] (Fig. 7). There was a heavy concentration of dairy cattle, hogs, and poultry and a high production of mixed grain, oats, hay, and ensilage corn. Hog raising has increased with the growth of dairying, the skimmed milk being used as an important source of feed. The capabilities of the soils for high yields of grain also favored the emphasis on

[10] For a map showing extent of clay plain see Chapman and Putnam: *Physiography of Southern Ontario, op. cit.*

[11] Iowa has the greatest density of livestock per unit area of any part of the U. S. A.

[12] An animal unit is equivalent to: 1 horse, 1 cow, 5 hogs, 7 sheep or 100 hens.

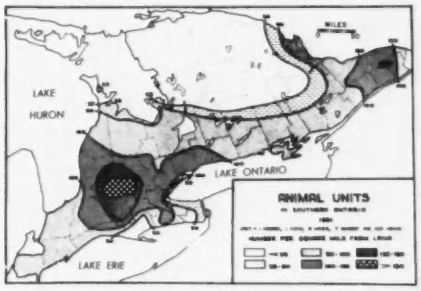

FIG. 7.

hogs. In addition to the high livestock and crop densities, the landscape generally exhibited a greater uniformity of development than most parts of Ontario. This agricultural area had a fairly large urban population and a higher than average rural population density. Quality of land is the most important of the factors underlying this development. Eighty per cent of the farm land of Middlesex, Perth, Waterloo, and Oxford falls into the first and second class categories as compared to 64 per cent in Halton, Peel, York, and Ontario and 42 per cent in Lanark, Carleton, Russell, and Prescott. However, one must also underline the human factor, since in parts of Waterloo County, particularly, the peculiar industry and efficiency of the farmers was largely responsible for the excellent development of mediocre land.

CAUSES FOR CHANGE

In 1880, there was a relatively small acreage devoted to cash crops other than wheat. The areas of specialized fruit growing were also small, and within the regions delineated on the map there was not the same intensity of land use as there was in 1951. The production of tree fruits was widely dispersed. By 1951, there was a contraction of production to the areas most favored climatically, near the ameliorating influ-

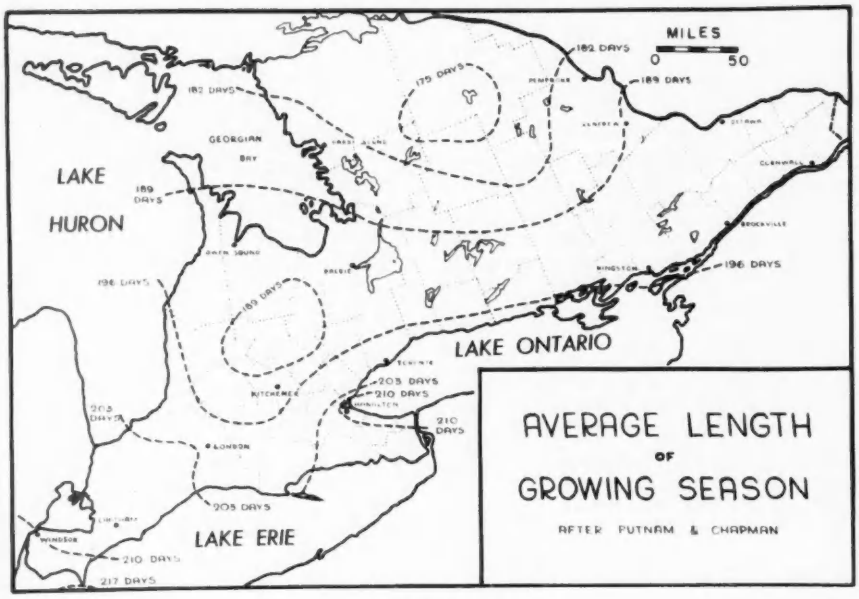

FIG. 8.

ence of Lakes Ontario and Erie and Georgian Bay. There were several areas in southwestern Ontario which had become very important for a great variety of cash crops including husking corn, sugar beets, soybeans, tender fruits, and vegetables and canning crops (Fig. 5). The great increase in demand for these types of agricultural produce stimulated this development while the localization of production has been related primarily to the length of the growing season (Fig. 8).

The contrast between the Pre-Cambrian area and the Palaeozoic lowland was much sharper in 1951 than it had been in 1880. This is one instance where bedrock accounts for the most striking differences in agricultural land use. This also leads one to suggest that these basic physical controls, though not necessarily as significant in the early stages of development, do eventually exert their full influence.

The drastic decline in agricultural land in the highly industrialized region along Lake Ontario and the rapid urbanization since 1940 has already been mentioned. The same trend has been evident in a much broader belt which extends northwards and westwards to include the agricultural heartland area. A high proportion of the total farm land in this region centering on Oxford and Waterloo counties is adaptable for cultivated crops. There is a high percentage of good quality land, the variable soils permit diversification, and the climate of the lakeshore part is especially suitable for tender tree fruits. The crucial problem is that of competition between land uses. As urbanization continues, an increasingly small area of this highly productive land will be available for agricultural use. For a time, more intensive use of remaining lands and a more complete application of scientific practices and technological

improvements may be sufficient to maintain production at present levels. Much might be done to decentralize industry within the region and to direct urban growth onto the poorer land types. Eventually, however, there will be a movement outwards from this core area. A more intensive development of outlying regions will then take place. The trend toward increased cash cropping in the Lake Erie counties will continue.

CONCLUSION

By 1880, agricultural settlement of the peninsula was almost complete. In these early stages of development, it has been seen that tradition and human factors played the major role. The period between 1880 and 1951 was marked by a retreat from the less favorable areas and a much more intensive development of the productive lands. It is evident that economic factors were primarily responsible for initiating the changes in types of production generally, but that climate, relief, and soils have been the main determinants of the characteristic patterns, locally. It would appear that, in the latter half of the 20th century, the frontier of extensive land use will be rolled back, though one hopes that history will not repeat itself and that no attempt will be made to redevelop land which is inherently unsuitable for agricultural use.

THE DAIRY INDUSTRY OF THE HAWAIIAN ISLANDS

Loyal Durand, Jr.

Professor Durand of the University of Tennessee spent the school year, 1957–1958, as Visiting Professor at the University of Hawaii.

FRESH milk is one of a small group of commodities in which the Hawaiian Islands are self-sufficient. In this respect milk is like sugar, pineapple products, and some few tropical fruits and vegetables. All other foods are imported in whole or in part, and it is significant that the list of imports includes manufactured dairy products, all of which are received from outside the Islands—from the mainland of the United States, from Australia, and from New Zealand.

The maintenance of a dairy industry in Hawaii is more than 70 per cent dependent upon imported feeds from the Mainland and from the Philippine Islands. In this respect, dairying is economically different from the two principal agricultural activities, the growing of sugar cane and of pineapples. About 30 per cent of the feed for Hawaiian dairy cattle, however, is provided by locally-grown Napier grass and by pineapple bran, a by-product of the canneries made by drying and pulverizing the shells and butt ends of the pineapple.

The value of dairy production first surpassed the value of the Hawaiian beef cattle enterprise in 1953. It has continued its relative position since that year. Its post-war rise to prominence reflects the increasing population numbers, the post-war settlement of many persons from the Mainland in Hawaii, and the increasing Westernization of Hawaii's inhabitants, many of whom were born in the Orient or at least are only one generation removed. However, per capita consumption of milk in the Islands is only half that of the continental United States. When schools are closed, and the children of Oriental heritage do not receive "school milk," the dairy companies of Hawaii are faced with a surplus.

Dairying in the Total Agricultural Scene

Dairying though third among Hawaii's agricultural activities is a poor third. During recent years the total value of farm products in the Territory has averaged slightly more than $300 million in value. Sugar has contributed 48 per cent of this, pineapples 39 per cent, livestock products 9 per cent, and diversified crops only 4 per cent. The plantation crops continue to dominate. Sugar cane is now grown by 28 plantations and on 221,000 acres of land. Pineapples are grown on 77,000 acres by eight plantation companies. In contrast, diversified crops, which range from the vegetable, fruit, and nut crops to the production of bananas and coffee, are raised on 3364 very small farms, 994 of which are coffee farms. Livestock is reared on 1141 farms, 87 of which specialize in dairying, 386 in beef cattle, 358 in swine, 306 in poultry and eggs, and four in sheep.

Dairying in Hawaii does not use much land. The majority of the dairy cows are continuously confined in small enclosures, and are stall-fed in the milking parlors or trough-fed in the yards. The

TABLE I

Year	HAWAIIAN ISLANDS		HONOLULU COUNTY (OAHU)
	Cows milked (number)	*Whole milk sold (gallons)*	*Whole milk sold (gallons)*
1899	Not available	84,451	Not available
1909	Not available	740,184	Not available
1919	4,587	1,166,531	927,635
1929	6,289	3,064,240	2,349,661
1939	8,287	4,442,013	3,477,874
1949	8,730	7,934,000	6,100,000
1950	9,900	8,906,000	.....
1951	11,090	9,609,000	.....
1952	10,750	9,311,000	7,759,250
1953	11,360	10,061,000	8,468,000
1954	11,120	10,126,000	8,515,000
1955	11,340	10,481,000	8,910,000
1956	12,570	11,697,000	9,874,250
1957	12,780	12,417,000	10,824,000

Pre-World War II data from United States Census; post-war data from *Statistics of Hawaiian Agriculture* issued by the Hawaiian Crop and Livestock Reporting Service—data by counties separated after 1952.

swine and poultry farms likewise utilize only very limited land areas. The beef enterprise, however, is an extensive user of land. Cattle farms and cattle ranches cover more than a million acres—nearly one-fourth of the total land area of the islands, and about three-fourths of the area of the land in farms. The visitor to the Hawaiian Islands cannot fail to see the sugar, pineapple, and cattle lands. He is likely to be completely unaware of the existence of dairying and the other livestock enterprises.

DAIRYING IN THE TOTAL ECONOMIC SCENE

The "big four" of the Hawaiian Islands, in order, are the Armed Forces of the United States, the sugar industry, the pineapple industry, and the tourists (visitor is the local name). All are inexorably intertwined with the commerce of the islands. The four, with the commerce, the service occupations, and a large construction industry provide most of the local employment.

The Armed Forces funneled $307 million into the economy of Hawaii in 1957. Military expenditures alone were greater in value than the total agricultural output. Total federal expenditures reached about $375 million. The Armed Forces employ nearly 17,000 civilian workers, and indirectly help sustain many service occupations and a very large construction industry valued at $111 million in 1957 and employing 11,500 workers. During the third quarter of 1957 the Armed Forces spent $80 million. This, alone, exceeds the total income of $77.6 million for the tourist industry of the entire calendar year.

Goods and services sold to Mainland businesses, to transportation companies, and to transients amounted to more than $100 million in island income. These activities overlap, in part, the extensive commerce.

The commerce of the islands involves the export of raw sugar, canned pineapple products, canec wallboard (from cane refuse), canned fish, floral material (particularly orchids), and coffee for blending. The principal imports are food, feed, raw materials, construction materials, lumber, cars and trucks, machinery, household appliances, and clothing. Cloth is imported for manufacture into special island clothing.

Dairying and the other livestock activities are minor as compared to the foregoing. Yet it is the employment in the major activities that provides the market for Hawaiian dairymen. The dairy farms are completely market-oriented to the demand for fresh milk. They produce the milk for the more than half-million inhabitants. They provide a locally self-sufficient supply. In this, they have outstripped the other livestock activities. The poultrymen meet only 70 per cent of the demand; frozen and canned chicken is imported; eggs are imported from the United States mainland and from Australia. Island-produced beef fills but 45 per cent of the island needs; the Mainland and New Zealand supply the rest. Hawaiian swine producers meet only half of the needs. More than 95 per cent of the lamb and mutton is from the continental United States and New Zealand.

THE MARKET

Four-fifths of the inhabitants of the Hawaiian Islands live on Oahu. Honolulu and the Island, but particularly the city, comprise the major market in Hawaii. The higher income groups are more numerous on Oahu than on the Outer Islands. The overseas commerce is dominantly at the port of Honolulu. Military personnel and military spending is nearly all on Oahu because of its strategic importance, the existence of 17 military and naval establishments, and the Naval Base and repair yard at Pearl Harbor. An estimated 55,000 Armed Forces personnel and dependents, not recorded in the Census, are stationed on the island in military or naval housing, or live in Honolulu and its suburbs. Ninety-four per cent of the total tourist spending is on Oahu. The companies known as factors (originally sugar factors, but now in a wide variety of activities, including retailing) are all centered in Honolulu. Transient crews of ships and planes, one-day stopover trans-Pacific travelers or world travelers, visit and spend money only in Honolulu. Market orientation in Hawaii means dominantly the city of Honolulu and the island of Oahu. From the milk-sale standpoint, the fact that 45 per cent of the population is 21 years of age or under is also a significant market factor.

The livestock farms cluster near their market. Eighty-four per cent of the milk, 77 per cent of the swine, and two-thirds of the eggs are produced on Oahu; only the production of beef is unimportant on the island. Despite the small size of the island, only 589 square miles, the livestock farms themselves cluster as close as possible to their city market, and, equally important, as close as feasible to the port of Honolulu from which they obtain the imported feed to carry on their enterprises.

Only now, with the rapid expansion of the city of Honolulu across the former livestock farms, vegetable farms, and rice and taro fields of the southeastern part of the island, are the farmers being forced from the immediate environs of their market. Outlying areas of Oahu which are not in the two mountain ranges of the Island are largely held in sugar and pineapple plantations, whose land is not available for small farming. The Hawaiian land system, inherited from the days of the Kingdom, wherein large estates and trusts hold great blocks of land, and the land is leased rather than sold, offers further "blocks" to the movement of farms. Thus, at present, the dairy farms, clustered close to market and port, are being forced to "outlying" areas, principally "homestead" lands some distance removed from the immediate market. The transport of milk 30 or 40

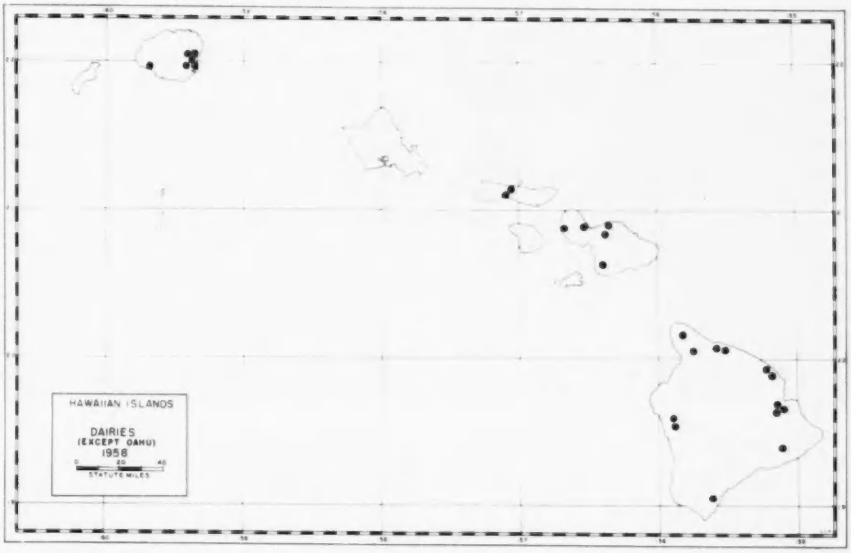

FIG. 1. The dairy farms of the Hawaiian Islands, 1958, except for the island of Oahu. Each dot represents one dairy farm.

miles on the Mainland is common; in the Hawaiian setting it is unusual, and now being "forced" by the urban expansion, with consequent increase in costs of an industry already costly with respect to labor and to imported feeds. These, and other problems of a market-oriented industry, in transition from a location immediately-at-the-market to an outlying position with respect to market will be examined. No doubt the low per capita consumption of milk in Hawaii is owing to high-cost factors as well as to the heritage of nearly two-thirds of the population.

DISTRIBUTION AND ORGANIZATION OF HAWAIIAN DAIRYING

The dairy farms of each of the Hawaiian Islands are entirely oriented to their local markets. Each island produces its own needs of fresh milk. The number of farms engaged in dairying, the number of cows milked, and the milk supply are adjusted to the demands of the inhabitants of each island. Despite the small size of all islands, except the island of Hawaii,

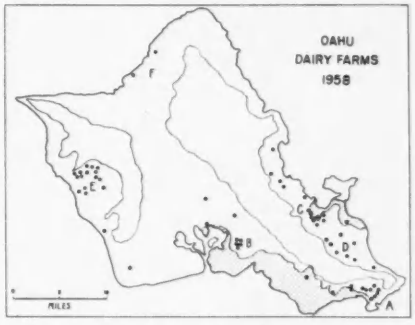

FIG. 2. The dairy farms of Oahu, 1958. Each dot represents one farm. All farms shown are on the Honolulu milk market. The six dairy districts of the island are: (A) Koko Head; (B) Red Hill; (C) Kailua-Kaneohe; (D) Waimanalo; (E) Waianae; (F) north shore of Oahu. The southernmost shaded area is urbanized Honolulu; the shaded area on the east shore depicts urbanized suburbs. The easternmost area enclosed by lines is the Koolau Mountain range; the westernmost area enclosed by lines is the Waianae Mountain range.

FIG. 3 (upper left). A representative dairy scene on Oahu. Note the large number of cows in the holding pen; the cows of the empty pen in the foreground are being milked. No vegetation exists in these small holding pens. Kiawe (algaroba) trees mantle the lower slopes in the middle distance, and the mountain side is covered with shrubs, cactus, and dry grasses. The scene is on the leeward side of a mountain range.

FIG. 4 (upper right). Dairy cows being fed in a holding pen on a dairy farm of windward Oahu; the windward face of the Koolau Range rises in the distance. Note the packed and trampled surface of the yard.

FIG. 5 (lower left). Nearly 800 cows are fed and maintained on this dairy farm. The milking parlors of the farm are in the left distance; the building to the right houses the manager's office and the offices of clerks and bookkeepers.

FIG. 6 (lower right). House provided for feeders and milkers on a large quasi-plantation dairy farm of Windward Oahu. The house is at one end of a row-development of housing.

the dairy farms, in their location, are close to their customers, and either concentrated or dispersed with respect to the pattern of population distribution.

Sixty-one dairy farms produce the milk supply of Oahu and the city of Honolulu. These (discussed later) are concentrated in well-defined districts, in respect to port, market, and land-availability factors.

Thirteen dairy farms, scattered around the perimeter of the large island of

Hawaii, supply the milk for the circumferentially-distributed people of the island. A small cluster of dairy farms near Hilo reflect the market of the 29,000 inhabitants of that city.

Six dairy farms on Kauai, five on Maui, and two on Molokai complete the number of specialized dairies of the Territory of Hawaii.

Three islands contain no dairy farms. Niihau is a privately-owned island peopled by about 250 native Hawaiians. Lanai is owned entirely by a pineapple plantation, and devoted entirely, agriculturally, to pineapples. Its inhabitants are mainly field workers of Japanese and Filipino extraction, dominantly the latter. Kahoolawe, eighth island in size, is uninhabited.

The dairy farms of the islands maintain 12,500 dairy cows. Nearly 10,000 of these are on the dairies of Oahu. Just over 1000 are on Hawaii, 800 on Maui, 600 on Kauai, and fewer than 100 on Molokai. Annual milk production on Oahu is over 10 million gallons. Yield of milk per cow is high in the islands, highest in Oahu, where greatest attention has been placed on good cows and on scientific feeding in response to the large market and the high price for milk. Milk consumption per capita is also highest on Oahu.

Many Hawaiian dairy farms maintain very large herds. On one farm on Oahu, 1000 cows are milked. Seven additional farms, five of which are on Oahu, maintain 300 or more milk cows; on one of these more than 700 cows are milked. Nineteen farms, 16 of these on Oahu, have herds of between 150 and 300 cows.

Unionization

The many large-herd dairy farms, like the sugar and pineapple plantations of the islands, are "big business." They are organized on a completely different basis than are the family dairy farms of the dairy regions of the middle latitudes of the world. The smaller dairies, family-operated, are comparable, however. Although not true plantations, as are the sugar and pineapple operations, the large dairy farms are managed and staffed in somewhat the same manner. Managers oversee the operations. Accountants and bookkeepers direct the offices of each farm. Full-time milkers and feeders work in shifts and on schedules—like factory operatives, except that the timing must be adjusted to the twice-a-day milking of the cows, and different shifts may start at the 4 a.m. and 4 p.m. milkings.

The quasi-plantation organization of the larger dairy farms, and the fact that some few of the dairies of the Outer Islands are associated with sugar plantations or with beef cattle ranches, has resulted in unionization of their personnel in union-conscious Hawaii. The dairy farmers and dairy workers of the islands are "teamsters." They belong to the national Teamster's organization (in Hawaii called Hawaii Teamsters and Allied Workers' Union). Sugar and pineapple workers are "longshoremen" and, like the dock workers, belong to the International Longshoremen's and Warehousemen's Union. The fact that unions have organized the dairymen reflects the quasi-plantation organization of the large (in numbers of cattle) dairy farms, and the existence (as on the true plantations) of large numbers of hired workers, small number of farms and farm managers, and small number of individual enterprises.

The Teamsters Union has organized all but a few of the single-family dairy farms. Many of the family farms are unionized, however, as a result of union organization of the milk bottlers and distributors. For example, there are but four wholesale and retail milk dis-

FIG. 7 (upper left). The open-sided milking parlor (left) and bottling plant (right) of a dairy farm on the island of Kauai. Pasturing of cows is more important on the Outer Islands than on Oahu; the pasture in the foreground is being allowed to regenerate. Many of the dairymen of the Outer Islands are both producers and distributors of milk.

FIG. 8 (upper right). Example of the importance of persons of Portuguese and Spanish ancestry in dairy farming in the Hawaiian Islands. The scene is on Kauai. Plantation-owned sugar cane is to the right; the entrance road to the dairy winds through more than a mile of sugar cane fields.

FIG. 9 (lower left). The large dairies have invested heavily in roads through the holding pens and feeding yards in order to facilitate the distribution of feed by truck. Four roads of this type thread the cattle yard of this farm. Note the concreted feed trough.

FIG. 10 (lower right). Homemade wooden feed troughs on a medium-sized family dairy farm. This line of troughs, on the outer edge of a holding pen, has been placed to take advantage of a short dead-end public highway for the distribution of feed.

tributors on all of Oahu, each in Honolulu; two of these companies are parts of national organizations. Contracts with these companies require that all milk handled be union-produced and delivered; even a single family operating a dairy farm must join the teamsters if they sell their milk to these large distributors; the "penalty" for not doing so is loss of market.

The two smaller milk distributors of Oahu are non-union. One receives milk

from five family farms, the farmers not wishing union affiliation. The other receives its milk from but two farms—one operated by the company and one family farm. Their total receipts are about 80 cans of milk a day.

The dairy farms of the Outer Islands are commonly both producers and distributors of milk. They maintain farm bottling plants. Unionization varies. In some cases, the farmer himself bottles and delivers the milk.

The Dairy Farmers

Dairy farming in the Hawaiian Islands is principally an occupation of white (Caucasian) farmers, secondly of farmers of Japanese ancestry. In the Caucasian aspect, dairying is likewise unique in the islands.

The non-dairy farming of Hawaii is rarely engaged in by persons of Caucasian ancestry. More than 93 per cent of the vegetable farms of the islands are operated by Japanese; the rest of the vegetable growers are mainly of Chinese or Korean descent. Seventy-two per cent of the poultrymen are Japanese, the remainder principally Chinese or "quasi-plantation" large operations employing Japanese or Filipino labor. The commercial swine farmers are predominantly of Okinawan ancestry, secondly Japanese; on Oahu the larger operators employ Filipino labor to cook and feed the garbage upon which the animals are maintained in large part. The coffee growers are almost entirely of Japanese descent. Although the sugar and pineapple plantations and the beef-cattle ranches are Caucasian-owned, managed, and operated, the labor is performed by others—mainly by Filipinos and Japanese on the sugar plantations, Filipino workers in the pineapple fields, and Part-Hawaiian or pure Hawaiian ranch hands.

Two-thirds of the dairymen are farmers of Caucasian ancestry. Portuguese are most numerous, followed by persons whose ancestors came from Galicia in northwestern Spain. Portuguese and Spanish operate the majority of the family dairy farms. Some few persons of American mainland background also operate family dairy farms, but are more common as managers of the larger dairies.

Among the names of island dairymen, illustrating the Portuguese-Spanish-Mainland importance on the dairy farms, are such as Brazil, Carlos, Campos, Costa, Ferreira, Foster, Freitas, Knowles, Medeiros, Moniz, Ornellas, Rapoza, Santos, Toledo, Vause, and White. Some names are repeated several times as a result of brothers on other dairy farms.

Persons of Portuguese ancestry have a reputation as dairymen in Hawaii—as the Japanese have in the growing of vegetables, and pure and Part-Hawaiians have as ranch hands on the beef-cattle operations. Not only do the Portuguese operate many of the family farms, but they are found as hired hands on the medium-size dairies, and as milkers on some of the larger ones.

The dairymen of Japanese ancestry are native-born Americans who have become familiar with dairy cattle through a start as milkers on the large farms, or as children of milkers. World War II also operated, especially on Oahu, to bring many Japanese into dairying. At the time many defense jobs were closed to alien Japanese; the high wages attracted Portuguese milkers from the farms to military installations and to work at Pearl Harbor. The dairies replaced the milkers with the Japanese; thus they have engaged in the industry, on the whole, only during the last 18 to 20 years. Today, too, some dairymen of Japanese ancestry

are younger graduates of agricultural colleges.

The large "factory" dairy farms, milking 200 or more cows, are Caucasian-owned and managed. The managers are both Mainland-trained and Hawaiian-trained. The milkers and feeders of the present on these farms are mainly Japanese or Filipino, with a sprinkling of Portuguese. The Japanese workers are native-born, but the Filipinos are aliens who have left the plantations for dairy work; they have been trained in it in Hawaii.

THE MAINTENANCE OF DAIRYING IN HAWAII

The dairy cows of Hawaii are nearly all of the Holstein-Frisian breed, purebred or high grade. The black and white dairy cows are so usual that many islanders assume that all dairy cattle are of this breed. One large farm on Oahu maintains, in addition to its Holstein herd, enough Guernsey cows to supply the entire market for Guernsey milk distributed by one of the large bottlers. Mixed herds are uncommon; some few of the family dairy farms, however, do have occasional Guernseys, Jerseys, Brown Swiss, or Milking Durhams in their herds.

Pastures are uncommon, especially so on Oahu. Instead there are "waiting yards" (called holding pens) surrounding the milking parlor. Troughs in these yards are utilized for feeding; the feed placed in them is the main source of food, such grass as is in the enclosure being supplementary only. Some of the holding pens contain so many cows that all vegetation is lacking, and the soil is packed and trodden into a concrete-like consistency in dry weather and is ankle-deep in mud during wet weather. Many of the holding pens are concreted in whole or in part.

Three prominent landscape elements, in addition to the cows themselves, which characterize the dairy farms are open-sided milking parlors, enclosed buildings in which feed is stored, and near-by fields of Napier grass.

The milking parlor in Hawaii is open on all sides; a roof shields the inside from both the tropical sun and the tropical shower. Thus, from the outside, one can see the rows of stanchions, the feed troughs which the cattle face (and eat from) while being milked, the equipment for piping the milk from milking machine to the tanks and coolers (in enclosed rooms at one corner of the parlor), the gutters in the concrete floor, and the activity of the milkers. All operations are under the strict rules of the Territorial Department of Health, whose standards are comparable to those of the United States mainland.

The feed-storage building is large or small, depending upon the size of the herd. It may be a Quonset hut or a World War II "surplus" building. Two to three or more galvanized-iron buildings, usually connected, and 50 feet or more in both length and width, characterize the larger dairies. The roof level may be 30 to 40 feet above ground level. Within the feed-storage buildings tractors and lifting-forks are operated for stacking the bags of feed. Also, feed-mills and feed-grinding and mixing machines are operated. The proprietors of small dairy herds have less impressive feed-storage buildings. Between buildings and holding pens, and fencing-in the holding pens, a common sight is the steel landing mat for beach landings during World War II; these "surplus" items, sold by the Armed Forces following the war, are usual fencing materials on the smaller-herd farms.

Fields of Napier grass are usual, and represent the only farm-grown feed; in fact, some dairies are so hidden from the road by the abundance and luxuriance

FIG. 11 (upper left). Open-sided milking parlor on a family-operated dairy farm in the Lualualei Homesteads of Leeward Oahu. The cows are being milked; the door to the right is one entrance to the feed storage building. The flat crest of Mt. Kaala, highest point of Oahu, appears in the distance.

FIG. 12 (upper right). Part of the Napier grass field, and the open-sided milking parlor of a family dairy farm operated by a dairyman of Japanese ancestry. Fifty-six cows are maintained on the farm. Dairy farms operated by other than Caucasians are not common; this is the only one pictured with this paper.

FIG. 13 (lower left). An example of an "older" dairy farm in Oahu, one which is now on the urban fringe of Honolulu. The pasture is an inheritance from the past; the semi-enclosed connected buildings likewise are former types, now replaced on nearly all dairies by the open-sided milking parlor. At present this farm is an "island" of rural land-use, surrounded on all sides by urban developments.

FIG. 14 (lower right). The large feed storage buildings on a large-herd quasi-plantation dairy farm.

of the tropical vegetation that only the Napier grass is an indicative item of their presence.

Napier grass, a tropical broad-bladed perennial grass, is not unlike sugar cane in general appearance. The grass grows to a height of ten to twelve feet. Its stalk becomes quite tough and cane-like, but its many blades provide feed of some succulence for a tropical grass. Three to four cuttings of Napier grass are obtainable each year. The grass is cut and chopped into coarse sizes by machine in the field, and the chopped

FIG. 15 (left). A field of Napier grass with a growth of a month to six weeks. Note the very broad blades of this tropical grass.

FIG. 16 (right). The Napier grass in the foreground has been harvested for dairy feed; the thick cane-like stalks remain, in part, as a residue from the harvest. The ten to twelve feet high Napier grass in the background is ready for cutting and chopping. Note the similarity in appearance of Napier grass and sugar cane.

grass is blown from the cutter (as in filling a silo) into trucks driven alongside the machine. The chopped grass is then stored in the feed buildings, either in bins or in heaps on the concrete floors. The rapid growth made by this grass, its height and quantity of vegetation, and the assurance of three-plus cuttings per year permits a four to five acre field to supply 50 to 60 cows with this part of their feed—which has to be supplemented with other feeds. Even a dairy on a ten-acre plot, a usual size of many family farms, can use half of the area for farmstead, holding pens, milking parlor, and feed buildings, and half for Napier grass. Its requirements for land area remain small.

The Feed

The importation of feeds, the trucking of bagged feed from pier to farm, the storing and mixing of feeds from diverse sources, and the manual labor of distributing feed to the dairy cows are all integral parts of dairying in the Hawaiian Islands. One farm on the north shore of Oahu trucks 1000 tons of feed a month from the docks of Honolulu across the island to its feed-storage buildings. The dairy industry of Hawaii is actually supported by extensive land areas on the continental United States.

The feeds utilized in Hawaii include barley, wheat, corn, bran meal, linseed meal, alfalfa, mill run, sugarbeet pulp, molasses, copra pellets, pineapple bran, and chopped Napier grass. Farms on the dry Leeward sides are able to use some local seed pods from the Mediterranean-type kiawe (algaroba) tree. The feeds are mixed in various ways and proportions to provide a balanced dairy ration.

The feed barley is principally from California sources in the drier portions of the Central Valley of the state. The wheat, corn, bran meal, mill run, and linseed meal are from Middle Western sources. Sugarbeet pulp (dried) is provided by the sugarbeet mills of the irrigated valleys of the Western United States (arch enemy, market-wise, of the Hawaiian sugar cane growers for the

FIG. 17 (left). The trucking of imported bagged feed is an ever-present aspect of dairying in Hawaii. The truck, just arrived from a Honolulu warehouse, is backing into the feed storage building.

FIG. 18 (right). Pasturing of dairy cows is important on the Outer Islands, almost non-existent on Oahu. These two pastures are on the same farm in the Wailua Homesteads, island of Kauai. The herd is rotated between them, and will soon be moved to the pasture on the right. Mt. Waialeale, in the distance, rises to more than 5000 feet and receives more than 450 inches of rainfall in a year.

sugar market of the Western United States), and is mainly from Colorado and western Nebraska. The liquid molasses is shipped via the Panama Canal from Louisiana; however, today the sugarbeet factories of the West add the molasses to their by-product beet pulp, dry the mixture, and export the resultant feed in bagged form. Baled alfalfa is shipped from the irrigated valleys of the Western United States and from the island of Molokai. Copra pellets are received entirely from the Philippines. The by-product of the Hawaiian pineapple canneries, pineapple bran, is fed principally to the dairy cows of Oahu.

Local feed, in addition to pineapple bran, Napier grass, and the small quantities of seedpods from the algaroba tree, is such alfalfa as is grown under irrigation on Molokai. Neither Molokai alfalfa nor island-produced pineapple bran is produced in enough quantity to meet the demands of the dairymen.

The production of alfalfa on Molokai is a recent development. Its presence is due to the experimentation of one agricultural scientist with the use of brackish water on the crop. Shallow ditches were dug to the water beneath dry, central Molokai, near Kaunakakai. Experimental fields were laid out on the lands of a ranch company. The use of the brackish water proved successful, and the company now has 150 acres of alfalfa. Although the total acreage is small, the growers obtain several cuttings a year, and are able to market baled alfalfa in Honolulu at 60 dollars a ton. The importance of the development is evident in view of the cost of mainland alfalfa in Honolulu—90 dollars a ton (11–17 dollars in western irrigated valleys). Prospects for future expansion of the Molokai acreage are good.

There is regional differentiation between the dairy farms of Oahu and the dairy farms of the Outer Islands in the percentage of local feeds used. Oahu farmers depend heavily upon pineapple bran and use most of the Molokai alfalfa, as well as Napier grass, in their

FIG. 19. The exception on Oahu—a dairy farm on a large acreage, with cropped fields, and pastures rather than close-in holding pens. The whole arrangement of the farm is shown.

30 per cent of non-imported feeds. Outer Island dairymen depend less upon the bran, more on pastures, which are feasible on their less expensive land. Moreover, they are not at the chief source of the pineapple bran, the Honolulu canneries, although there are small canneries on Kauai, Maui, and Molokai. The pastures are seeded with various tropical grasses introduced from other areas. If the dairy farms were at high elevations, as some of the cattle ranches are on the island of Hawaii, middle latitude grasses would thrive. Even with greater dependence upon pasture grasses, Outer Island dairies still use some 70 per cent of imported feed in their feed mixtures.

Replacement Cows

Hawaiian dairying depends upon constant and continuing replacement of dairy cows, the cows being shipped from the mainland of the United States. By regulation, all cattle must be landed at the port of Honolulu for compliance with inspection and disease purposes. During the calendar year of 1957, two thousand six hundred forty-seven dairy cows were brought to the islands; most of these were replacement cattle; some were brought for expansion of the

herds. Thus, at any given time, one-fifth of the cows of Hawaii are newly-arrived animals.

A cow freshens in Hawaii two or three times—more if an outstanding and highly profitable producer of milk. Breeding is by artificial insemination. As soon as signs of decreasing milk yield appear, the cow is replaced. The cow is, in effect, a machine which must justify its cost of operation, the labor and feed input, and the high costs of the materials used in its maintenance.

A very few of the large-herd quasi-plantation dairy farms operate "replacement farms" in California. On these, they rear their own calves. Also, on their own lands in the islands, they rear calves and heifers, and graze and feed dry cows being retained. Other farmers purchase their replacement cows from buyers who have obtained the animals chiefly in the Pacific Northwest and in California.

The sale of veal calves and of old dairy cows to stockyards in Hawaii is a by-product of dairying in Hawaii. All male calves are disposed of for veal.

LAND PRESSURE AND DAIRYING ON OAHU

The shortage of land, and especially of available land for dairying (and for diversified farming) on Oahu near Honolulu is forcing a relocation of dairy farms and a reorientation of the pattern of milk transport from farm to bottler. The rapid post-war growth and expansion of Honolulu, the shortage of fee simple land (which can be purchased), and the high price of land leased from the island estates are "forcing" dairy farms to more "remote" locations on the island. The last few years have witnessed the movement of dairy farms to locations farther from Honolulu; the historic sites have been abandoned to urban expansion. Moreover, the estates, one of which is the largest land owner on Oahu, are interested primarily in the development and leasing of their land for city subdivisions. Large blocks of present dairy, swine, poultry, and vegetable farms are to be developed for city leasing by 1960 to 1961. Under the Hawaiian land systems the land is leased for varying periods of time—the maximum usually 55 years. Houses or other structures built on the leased land belong to the builder (lessee) and may be moved at the termination of the lease; if the estate wishes the land for other purposes, and does not renew the lease, the land itself is "returned" to the owner.

Land Practices

Few dairy farms of Oahu are located on fee simple land, especially if the farm is close to the Honolulu market. Land is too expensive; taxes are too high. Former dairy farms and former government land near Diamond Head sold at auction recently at an average price of $2.10 a square foot. The square foot is the usual area in Oahu for valuation and sale of land.

Most of the dairy farms of Oahu lie on leased lands. Since hereditary dairy locations are close to the city, the landowners, at present, are leasing for short terms only. One of the largest-herd farms of the island has about half of its holding pen area on only a 30-day lease. Within the last ten years the desire of a landowner to develop an area for suburban housing, and to terminate a lease, resulted in a lawsuit which received newspaper publicity for some weeks. The farm relocated eventually.

A third land practice in Hawaii is the existence of homestead lands. The homesteads are today a most critical factor in the locating of "removed" dairies, despite the fact that their total area on Oahu is small; the newest dairy

cluster is entirely on homestead lands. The original homestead laws were passed during the days of the Kingdom of Hawaii. A homestead law of 1884 was replaced in 1895 by the Republic of Hawaii; the Act of 1895, with amendments, is still in force; when the islands were annexed to the United States in 1898, Congress directed that the Hawaiian laws regarding land be continued, and the land laws of the Mainland not apply to the islands.

The homestead laws of Hawaii were based upon the assumption that the islands should have family farms of middle-latitude type, operated by persons of European ancestry. Government land and some other lands not alienated by plantations or by royal grants (these last the fountainhead of many of the present estates) were laid out in blocks, and divided into farms of 20 acres. The individual farms were purchasable in three ways—a homestead lease of 999 years, a right-of-purchase lease for 21 years with option to purchase outright after three years, and an installment-purchase agreement. Homesteading in Hawaii did not work out as anticipated; conditions differed from those of the American West, which was a pattern used. Although many of the Portuguese brought to the plantations between 1876 and 1887 left the sugar cane fields, and availed themselves of the opportunity to obtain a farm, few others did. European or American farm immigrants were not attracted. The homestead areas continue; their existence on Oahu is today a magnet in the relocation of farms.

The fourth landholding type of Hawaii is the land of the Hawaiian Homes Commission. The United States Congress set up the Commission in 1921; it is operated locally under revolving funds. The idea was to resettle Hawaiians. At present the leasing of Homes Commission lands requires that the lessee be possessed of at least half-Hawaiian blood. Leases are exceedingly nominal —city lots on Homes Commission land are rented on long-term leases at a fee of only $1 a year; land suitable for farming is rented in blocks up to 40 acres in size at $1 a year for the whole area; grazing land can be rented for $1 a year in blocks up to 2000 acres in size. The existence of Homes Commission lands has had little effect on the relocation of dairy farms; the dairy farmers cannot meet the half-Hawaiian requirement.

The Dairy Districts of Oahu[1]

The original location of Oahu's dairy farms was immediately to the east of Honolulu, on fee simple and leased land near Diamond Head, and at the head of the short, steep-gradient valleys of the southeastern part of the island, between

[1] Several land utilization maps of the Hawaiian Islands and particularly of Oahu have been published. They may be summarized as follows:

Otis W. Freeman: "The Peopling of Hawaii," *Journ. of Geog.*, Vol. 27, 1928, pp. 125–141. Land utilization map of Oahu on p. 126.

Otis W. Freeman: "Economic Geography of the Hawaiian Islands," *Econ. Geog.*, Vol. 5, 1929, pp. 260–276. Land utilization map of Oahu on p. 261.

"Land Utilization in Hawaii," *Geogr. Rev.*, Vol. 18, 1928, pp. 330–333. (Note on "The Economic Geography of Hawaii," by O. W. Freeman in University of Hawaii Research Publication No. 2.) Map of land utilization of Oahu on p. 331.

Stephen B. Jones: "Geography and Politics in the Hawaiian Islands," *Geogr. Rev.*, Vol. 28, 1938, pp. 193–213.

Freeman's maps of 1928–1929 still hold good, in general, at present. Chief changes have been (1) the elimination of the vegetable, rice, and dairy areas near Honolulu, and (2) the elimination of the sugar cane plantations, and mills, in the Waimanalo and Waianae areas. All south shore fish ponds are gone except the one shown in Figure 20 of this article. Jones' maps show the population pattern of each island, and the sugar and pineapple, and coffee lands. Although population has increased greatly in numbers, the population *patterns* remain generally the same.

A recent map of land utilization on Oahu is found on page 341 of Otis W. Freeman, et al., *Geography of the Pacific*, New York, 1951; and there are maps of Oahu's elevations, rainfall, soils, and vegetation on pp. 336–337.

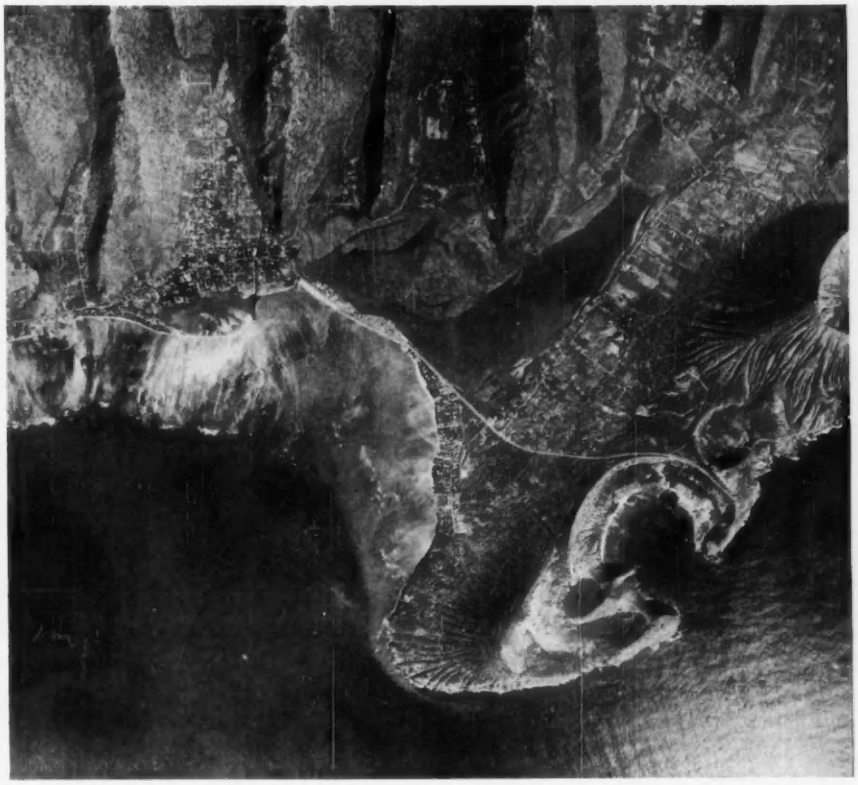

FIG. 20. The Koko Head district of southeastern Oahu from the air. The large headland is Koko Head. The semi-circular shaped bay, Hanauma Bay, occupies its former crater. The mountain and crater on the right edge is Koko Crater.

Ten of the 12 dairy farms mapped on Fig. 2 occupy sites in the narrow valleys leading from the Koolau Range to the Pacific. One is at the head of the westernmost-shown valley, one farther down the same valley. Two dairy farms remain at the head of the completely-urbanized triangular-shaped valley of the upper left. One dairy is at the head of the rectangular-shaped valley in the upper center. Five dairy farms are located in the valleys north and east of the large fishpond, which is separated from the ocean by a dike, across which there is a road.

Many of the white-roofed buildings in the scene, such as in the rectangular-shaped valley, are chicken houses and structures for the cooking of garbage for the feeding of swine. The Koko Head area, at present, is important in egg production as well as in dairying, and is the leading swine-feeding district of Oahu.

All of the flattish land shown in the view is scheduled for urbanization by an estate. All farms will undoubtedly soon have to be relocated. (Photo courtesy *Soil Conservation Service.*)

Diamond Head and Koko Head. Only these last remain (A on Fig. 2). Reflecting this original location is the bottling plant of one of the two national dairy distributors; it lies well to the east of downtown Honolulu.

The farms near Diamond Head have all had to relocate; the largest-herd farm of Oahu moved from its completely-urban surroundings in mid-1957. The Koko Head cluster will no doubt shift soon; nearly all of the farms are located on leased land which the estate-owner has scheduled for urban development in 1960–1961. The farms at the heads of the narrow valleys are now almost com-

FIG. 21 (left). A scene photographed two days after removal of a dairy farm from urban Honolulu. Feed troughs and feed bags have been left; telephone poles are down. Within a few days the land was graded for urban development by its estate-owner.

FIG. 22 (right). Family farmers deliver their own milk to Honolulu distributors, sometimes in tank trucks as here shown, some in cans. The removal of dairies to "distant" Waianae has resulted in the formation of separate milk-trucking concerns. These now operate tank trucks and trailers.

pletely impigned-upon by city housing. The city of Honolulu, anticipating the urbanization and building a high school in one of the valleys obtained an injunction against a dairy farmer in December 1957, and forced him to move 115 cows to another location with but little notice.

The cluster of dairy farms at Red Hill (B on Fig. 2) are those that remain in the Pearl Harbor area. They occupy less than 100 acres of land, and are being pressed upon from all sides. To their immediate southeast is Fort Shafter, to their east is gigantic Tripler Hospital, the largest military hospital in the world. Aliamanu Military Reservation and naval housing areas are to their south. The Makalapa Naval Reservation and extensive naval housing and industrial areas associated with Pearl Harbor lie to their west. To their north is the city of Aiea, a naval reservation, and the numerous buildings and housing areas associated with CINCPAC (Commander-in-Chief, Pacific). The small farming area is all that remains of formerly extensive diversified farming and sugar cane plantations which stretched all the way from near downtown Honolulu to Pearl Harbor.

The Kailua-Kaneohe dairy district lies in Windward Oahu, on the rainy side of the Koolau Mountains (C on Fig. 2). It is accessible to Honolulu via the Pali road over the mountains, Kailua-bound traffic crossing the pass, Honolulu-bound traffic using a tunnel. A second road, completed in 1958, to the area utilizes tunnels in both directions. The existence of the Pali route, the high land prices in Honolulu, and the use of the automobile has permitted exceedingly rapid post-war urbanization in the area. Ten thousand cars a day cross the Pali with commuters. The urbanized district shown on Figure 2 is expanding by the day. One company alone is adding 2000 houses in a year. The dairy farms find themselves in semi-urban settings; some are actually in urban settings, with shopping centers, houses, and apartments between the farmstead and the road or street. Green Windward Oahu,

FIG. 23 (left). Cows of a dairy farm at feed troughs in a large holding pen—one which contains a little vegetation. Mormon Stake (church) in the background, Windward Oahu.

FIG. 24 (right). Two apartment buildings, each with full occupancy, on the site of the holding pen. Mormon Stake (church) in the background. From same spot as Fig. 23 but six months later.

to which some farms moved, and in which others were established, now finds itself, agriculturally, in the situation of the southeastern part of Oahu.

The Koko Head, Red Hill, and the Kailua-Kaneohe dairy districts face the problem of urbanization, removal of dairies to other locations, and increasing land values with increasing costs of their leases. Three or four dairies, farther north on the east shore of Oahu, lie beyond the present region of pressure. However, part of the area they occupy has been zoned for light industrial use—the islands hoping to attract industry. In contrast, three other dairy districts are newer in point of time, and are the districts to which dairy farms are being removed. These are Waimanalo (D on Fig. 2), Waianae (E on Fig. 2), and the north shore (F on Fig. 2). Interior locations on Oahu and much of the north shore and southwestern shore locations are not available; they are occupied by plantations and by military reservations.

The Waimanalo area (D) became available for farming when a sugar plantation ceased operation on December 31, 1947. Less than the total area is available to most because some of the land is under the Hawaiian Homes Commission. Furthermore, urbanization is creeping in from both northwest and southeast. Nevertheless the district has become one of expanding milk production, mainly on family farms.

Waianae, in dry Leeward Oahu, west of the Waianae Mountains, (E) has become the district of largest expansion of dairying on Oahu. The reason is almost entirely associated with the existence in Waianae of two blocks of homestead land, the Waianae Homesteads and the Lualualei Homesteads. Dairymen can obtain land on which to operate. Sixteen dairy farms, one somewhat removed from the chief cluster but on outlying homestead lands, comprise the present units; several other dairies are in process of negotiation for land and the transfer of their herds to Waianae. The increasing concentration of dairying in Leeward Oahu has resulted in the formation of the first milk-hauling firm on the island to haul milk for more than one farm. Indirectly, the concentration has been partly respon-

sible for the site of the new plant of the second national organization bottling and distributing milk; the plant is located well to the west of downtown Honolulu.

The Waianae dairy farms are on homestead and fee simple land in the Waianae Valley, a narrow valley leading westward from Mount Kaala, the highest point of Oahu. Although the Waianae Range receives much less rainfall than the Koolaus, Mount Kaala receives more than 70 inches a year—far more than the average of the rest of the western mountain range. Westward-flowing streams provide the water for irrigation of the farms. South of the Waianae Valley, and separated from it by a range of hills, is a large amphitheater-shaped basin; this is largely occupied by the 11,000 acre United States Naval Ammunition Depot, but its northern part is all homestead land; here are the remaining dairy farms of the Waianae cluster. The rapid growth of the Waianae area in dairy farming, coupled with its distance of 40 miles by road from downtown Honolulu, has posed problems such as the cost of feed-hauling and of milk delivery to bottlers, problems of increasing costs in these respects.

Only two dairy farms (F) are on the north shore of Oahu. One, the largest-herd farm of Oahu, moved from urban Honolulu in 1957. The other is in the Pupukea Homesteads—the only homestead land of the area. The existence of these homesteads may well serve as a magnet for future relocation of dairies forced from other locations.

SUMMARY

Dairying in Hawaii reflects the Western Culture of the islands. The farms are completely market-oriented. In numbers dairy farms are few. In milk production they are, on the whole, very large. In operation they are principally a Caucasian enterprise. In area the farms are small, little more than "standing-room only" for the cows. In the organization of the larger-herd farms, with "factory-milking, factory-feeding," unionization, and the punching of time cards by the workers, they are completely unlike the family dairy farms of the Dairy Region of the United States and Canada.

Dairying on Oahu was originally right at the market, in line with theoretical locations. Land pressures and increasing urbanization have forced them to "outlying" locations on the island. Increased transport of imported feed and of milk have added costs to an industry already dependent to a large extent on land areas elsewhere in the world for the feed supply to maintain dairy cows.

WORLD PRODUCTION AND USE OF STEEL SCRAP

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IT is probable that metals have been reused ever since they acquired significance in human affairs. But only in recent years has metal scrap become of great importance and the channels established whereby the old and worn-out metals go back to the factory to be fashioned anew. In 1955 the world production of steel was 265.2 million tons. Production of pig iron amounted only to 186.6 million tons. Some of this pig iron—perhaps 5 per cent—went directly into iron castings, and a small percentage was lost in the steel-making process. It seems that about a third of the steel was actually made from scrap.

There are technical as well as economic reasons for using scrap rather than pig iron, and the availability of scrap strongly influences the kind of steel industry that is established. A further reason for the importance of scrap is that its use conserves ore and coking coal. Figure 1 shows the expansion of iron and steel production in the United States. After about 1915 steel production began to exceed that of pig iron, and the discrepancy steadily grew. If we may assume that the difference was made up of scrap (in reality scrap consumption would have been appreciably greater), this country has used some 1600 million tons of scrap. Translated into terms of ore, this is equivalent to 3 billion tons of Mesabi hematite or 5 billion tons of Alabama red ore.[1] One can thus argue that without this large use of scrap, the Lake Superior deposits would long since have been exhausted.

It is well known that the open-hearth and electric furnaces have encouraged the use of scrap.[2] In both, the heat necessary for the chemical processes is supplied from without. In the only other significant process, the converter, the metal is supplied hot, and its temperature is maintained by the endothermic reactions which take place in the converter. Though small quantities of cold metal are sometimes added to the converter, any large scale use of scrap would chill the metal and interrupt the process. Very broadly, those regions which for technical reasons are obliged to use the converter are prevented from using scrap, except in very small quantities, and this fact has an important bearing on the geography of the industry.

The economy of using scrap in the open-hearth and electric furnaces derives from the fact that the steel scrap has already been refined. A large admixture of steel scrap reduces the per-

[1] These figures are greatly in excess of the known reserves in these deposits; see *Survey of World Iron Ore Resources*, United Nations, 1955, pp. 196–197.

[2] Albert S. Carlson and Charles B. Gow: "Scrap Iron and Steel Industry," *Econ. Geogr.*, Vol. 12, 1936, pp. 175–184.

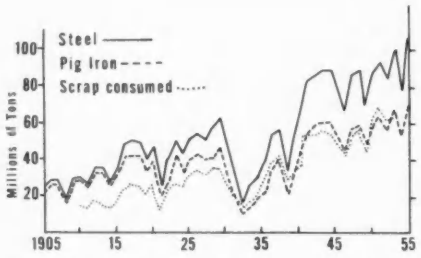

FIG. 1. Production of pig iron and steel and consumption of steel scrap in the United States, 1905–1955.

centage of impurities to be burned out and thus the volume of fuel consumed, and enables the process to be completed in a shorter time. The electric furnace, more costly in terms of fuel to operate than the open-hearth, normally uses only steel scrap.

The effect of a large use of scrap in the open-hearth is thus to increase the capacity of the furnace and to diminish the cost of fuel in relation to the amount of metal refined. A second economy to be derived from the greater use of scrap is on the smelting side of the industry. Scrap replaces pig iron, and thus diminishes the need for smelting capacity. The blast-furnace plant, with its ancillary sintering, coking, hot blast, and other equipment represents normally a much larger capital investment than the steel works. The reduction of its scale represents a saving in the cost of building a plant as well as a considerable reduction in the prime costs of making steel. The availability of scrap may thus make the difference between erecting a steel works and continued dependence on imports in some of the less developed countries.

In addition to its important role in steel making, scrap is used also in the foundry and blast furnace. The former does not concern us, and the latter is of relatively small importance. Under normal conditions the use of scrap in the blast furnace is highly uneconomic, as it involves using fuel to recarburize scrap that has already been refined. On the other hand, such a use of scrap may be necessary (a) to enrich the blast furnace charge or (b) to use up scrap which has an excess of deleterious substances, such as galvanized or high-sulphur steel. Zinc is removed with the waste gases and sulphur can be best eliminated by means of the blast-furnace slag. Such use of low-grade scrap would not, however, be regarded as good blast-furnace practice.

CONSERVATION OF IRON AND STEEL

A large proportion of the iron and steel that is fabricated in the metal-using industries ultimately returns to the market as scrap (Fig. 2). There is a small wastage owing to corrosion; very small metal articles are disposed of along with trash, and rather larger quantities are used as reinforcing in

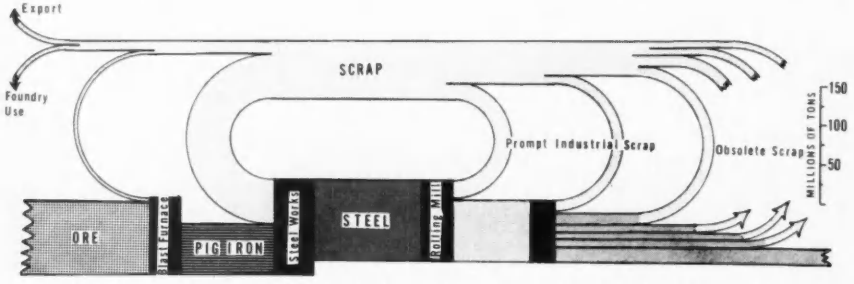

FIG. 2. Flow diagram of iron- and steel-making materials for the United States, 1955.

steel construction and are probably irrecoverable. To this must be added the more spectacular losses through the sinking of ships and certain types of wartime destruction, and the probably smaller losses of steel which are not recoverable for economic reasons, that is, quantities too small or too remotely placed to be worth the trouble.

Scrap is generated from the moment when pig iron runs from the blast-furnace. Scale and iron dust are swept up and sent back to the furnace. Poorly made steel ingots, misshapen slabs, and crop-ends of bars and sheets and trimmings from strip-mills all go back to the steel furnace within at most a few days. Any modern works in this way generates a large proportion—up to a half—of the scrap which it uses. A considerable amount comes from engineering works in the shape of turnings and clippings, and the motor industry is the biggest producer of this process scrap.[3] These types of scrap return quickly to the steel works and for that reason are termed "prompt industrial scrap." Up to a third of the scrap used by an American steel works is obsolete scrap, purchased usually through a dealer, and representing an original investment made from one or two up to 50 or more years ago. Prompt industrial scrap may be said to represent a fixed relationship to current steel consumption. If there is an expansion, it may be assumed that the proportions of damaged pieces, clippings, and crop-ends will remain constant. The same is broadly true of the engineering industries. They return as prompt industrial scrap a more or less fixed proportion of the steel they receive, highest in the case of the motor and light engineering industries, smallest in that of steel construction.[4]

Obsolete scrap, however, is a very variable factor. A survey recently conducted by the Battelle Memorial Institute attempted to show what has happened to the iron and steel produced in this country in the period 1881–1955:[5]

		Tons
Total inventory in 1881		61,000,000
Made 1881–1955		2,910,000,000
Withdrawn as scrap	930,000,000	
Lost through corrosion, export, etc.	540,000,000	
		1,470,000,000
Total inventory in 1955		1,501,000,000

The total inventory of iron and steel in primary use as well as in secondary use and obsolete is expected to rise to 1.72 billion tons in 1960 and to 2.06 in 1965. In each case, at least a third of the metal is considered to be either obsolete, and thus available as scrap, or in secondary use. It is difficult to form a precise estimate of the amount of this iron and steel that cannot come back into circulation. We know that losses at sea have accounted for 6 million tons of steel during the period 1881–1955. We do not know the extent of losses through corrosion and the amount which is irrecoverable for other reasons. The Battelle Institute estimates that 85 per cent of the iron and steel made is ultimately recoverable somewhere.[6]

[3] *Industrial Scrap Generation*, United States Department of Commerce (Business and Defense Services Administration) 1957, p. 3; *Analysis of Trends in Europe's Supply and Consumption of Iron and Steel Scrap*, United Nations, Economic Commission for Europe, 1948 (mimeographed, E/ECE/Steel/27).

[4] *Ibid.*, pp. 5–7 tabulates the scrap generating power of the metal using industries.

[5] *Final Report on a Survey and Analysis of the Supply and Availability of Obsolete Iron and Steel Scrap*, Battelle Memorial Institute, Columbus, Ohio, 1954, pp. 31–33. This estimate seems high. It was estimated that in the United Kingdom the total loss amounts to 35 per cent, Sir Harold Hartley, "The Recovery of Metals from Scrap," *Conference on Mineral Resources and the Atlantic Charter, The Advancement of Science*, Vol. 2, 1942, pp. 231–236.

[6] *Ibid.*, pp. 68–72.

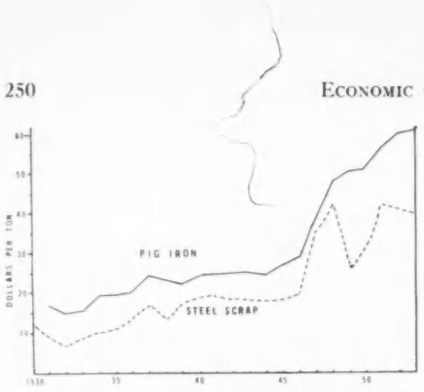

FIG. 3. Price of pig iron and high-grade steel scrap at Pittsburgh, 1930–1953.

No such inquiry has been made in other countries, but it seems likely that the recovery ratio may be somewhat greater in the United Kingdom, partly because a greater effort is made to recover small quantities of "backyard" scrap.[7]

It could thus be argued that, given a stable level of demand for steel, blast-furnace capacity need be sufficient only to make good the wastage from the total iron and steel inventory. But demand is increasing, and is expected to continue to increase during the foreseeable future. If, on average, steel goods have a life cycle of 20 years,[8] the maximum possible increment of obsolete scrap in 1957 would be about 30 per cent of the ingot production 20 years earlier, that is, about 15 million tons, a relatively small contribution toward a total production of nearly 120 million ingot tons. Thus a steadily rising steel production is possible only if the blast-furnace capacity increases at a slightly faster rate. But a recession or a leveling off of demand is likely to render part of this blast-furnace capacity redundant. This, compared with the high investment represented by a blast-furnace works, explains why in many quarters there is a reluctance to build additional blast furnaces if there is any possibility of using scrap instead of pig iron.

THE SCRAP MARKET

Process scrap from the rolling mill and engineering works is of known origin and quality, and it can be processed afresh in the steel plant without difficulty. Obsolete scrap is gathered from dismantled buildings, from shipbreakers' yards, from obsolete plant and equipment. Its exact origin and quality are not known. Some is foundry iron; some is tinned or galvanized; and amid it all there are likely to be small quantities of alloy steels. The channels through which process scrap is returned to the furnaces are usually clearly established, and in the case of "home" scrap represents only a bookkeeping item in the firm's accounting. On the other hand, some prompt industrial scrap and all obsolete scraps passes through the hands of a dealer.

The untidy but swiftly changing scrap yard is a familiar feature of industrial cities.[9] Iron and steel goods are brought in, sorted, and broken or sheared to manageable size. In some yards tinned goods may be electrolytically "detinned." Greasy items are burned to remove the dirt; small and pliable items are pressed into bales suitable for charging into the open hearth. Alloy steels must be separated from the rest, not only because they produce deleterious results in normal grades of steel but also because, if carefully graded, they fetch

[7] Information from Mr. Felix L. Levy of George Cohen Sons and Company, Limited, London. See "The Steel Scrap Drive," *Monthly Statistical Bulletin, British Iron and Steel Federation*, Vol. 28, January, 1953.

[8] This will vary with the degree of development of the economy. It is shorter in the U.S.A., where most machinery has an appreciably shorter span of life, and longer in underdeveloped countries.

[9] "A Modern American Scrap-Iron Yard," *Metal* Bulletin, No. 3166, January 31, 1947, pp. 11–14; Edwin C. Barringer: *The Story of Scrap*, rev. edit., Institute of Scrap Iron and Steel, Washington, D. C., 1954, pp. 86–94; Felix L. Levey: *The Usage of Scrap Iron and Steel for Melting*, George Cohen Sons and Company Limited, London, n. d.

a higher price than other kinds of scrap.[10] At the same time, screws and screw turnings, usually high in sulphur, are unsuited to the steel furnace, and commonly go to the blast furnace to be resmelted. The scrap yard thus serves to collect and sort scrap and to despatch it to iron and steel works and other consumers.

Scrap tends to flow unevenly, and its price, unless, as in Great Britain, this is controlled,[11] tends to fluctuate very widely.[12] A sudden increase in demand for steel can normally not be met by an increase in blast-furnace output. The result is increased demand and higher prices for scrap, which may even exceed the current price of pig iron.[13] Conversely, weak demand for steel leads to a more than commensurate fall in the price of scrap. On the other hand, boom conditions are more likely to be reflected in the scrapping of old plant and equipment and its replacement by new. Obsolete scrap is a by-product of technical progress, and, as with all by-products, its price is determined wholly by demand.[14] At lowest, the price of scrap is the cost of collecting it, and, at the opposite end, the marginal cost of sorted and graded scrap is higher than that of pig iron, because it represents pig iron that has been further refined. These extreme fluctuations in the price of scrap (Fig. 3) greatly influence the supply of obsolete scrap; it is not worth while scouring the farms and quarries for abandoned equipment when prices are low.

[10] Specifications for the many grades of scrap for the American market are listed in *Institute of Scrap Iron and Steel Yearbook*, 1957, Washington, D. C., 1957, pp. 45–53. See also *The Making, Shaping and Treating of Steel*, Seventh Edition, United States Steel Corporation, Pittsburgh, 1957, pp. 204–205.

[11] *Statutory Instruments, 1956, No. 631, The Iron and Steel Scrap Order, 1956*, gives the maximum price of each grade of scrap by geographical regions.

[12] D. Warriner: *Combines and Rationalisation in Germany, 1924–1928*, London, 1931, pp. 19–20, 166–168.

[13] This happened, locally at least, at the beginning of the Korean Crisis.

[14] U. S. Bureau of Mines. Materials Survey, *Iron and Steel Scrap*.

World Pattern of Scrap Generation

The world production of steel has, apart from short-lived recessions,[15] been climbing steadily since the large-scale production of steel was introduced a century ago. Most steel-making countries and several which have not yet entered the field have announced development plans, so that we may assume that this upward trend will continue. A fraction of the ingot steel produced will be returned to the works immediately as "prompt industrial scrap." This fraction will vary with the type of industry, and it may be said that, as a general rule, the more refined the industrial process, the larger will be the fraction of metal returned in this way. Prompt industrial scrap is much larger, in relation to ingot output, in the United States or Great Britain than in India or Australia.

Countries which have not possessed a steel industry until recently are not likely to produce important quantities of obsolete scrap. On both counts, therefore, newly industrializing countries are faced with considerable difficulties in their supply of scrap. This results, as has been noted above, in an increase in blast-furnace capacity, which such countries are least able to afford, and in an import of the raw materials of the smelting industry.

It is apparent today that, in the underdeveloped countries, the prestige to be derived from the possession of an iron and steel industry outweighs the

[15] The most marked was that of 1930–1935; other occasions were in 1921–22, 1938, 1945–8, and 1954.

technical and economic obstacles in the way of creating it. In the developed countries, on the other hand, the availability of scrap has an important influence on the location of a plant as well as on the process adopted. Thus, it has been stated that the Fairless Steel Works is able to obtain all the scrap needed from the Philadelphia area, and it has been argued that the availability of scrap would, other things being equal, make the New England coast a suitable site for an iron and steel works.[16] The availability of scrap in quantity and over a prolonged period of time can be a determining feature in the location of plant. In the United States, an average 100 tons of steel is made from 54 tons of steel scrap and 90 tons of Mesabi-grade ore and a similar quantity of coking coal. If we add that the scrap travels only a short distance, is usually cheaper than pig iron, and permits a higher output per steel furnace to be achieved, the economies of a "scrap-oriented" industry become apparent. The importance of scrap is becoming a factor of importance also in the location of the Soviet steel industry,[17] an indication of the country's growing industrial maturity.

We have seen already that, though there is a large pool of obsolete scrap, steel returns to the scrap market only after a delay of, on average, some 20 years. In a period of sharply increasing production, total production of scrap cannot possibly be as great as the industry itself considers technically desirable. There is thus international competition for scrap which forces prices so high that the construction of additional blast-furnace capacity is begun in some countries.[18]

Demand for scrap is influenced by the steel-making process in use. At the one extreme, electric steel uses almost exclusively carefully graded scrap. Here the high cost of the power used makes it imperative to reduce to a minimum the need for refining. At the opposite, the converter process, whether acid (Bessemer) or basic (Thomas), theoretically requires no scrap, though it is sometimes necessary to add a small quantity to the molten metal to lower its temperature. A very highly phosphoric ore makes the basic converter process desirable, and in Lorraine, Luxembourg, and Belgium, where the available ores are predominantly highly phosphoric, the Bessemer process predominates. In Colombia, where highly phosphoric ores are being used at the new Belencito works, the basic converter process has also been adopted.[19] In such a works the disposal of home scrap becomes a problem. In Lorraine an open-hearth works was built in order to use it. It seems likely, however, that, if oxygen is used for blowing the converter, the higher temperature produced will permit the use of up to 20 per cent of steel scrap, thus providing an outlet for the "home scrap" of the works.[20] It has been suggested, however, that "the combination of converter operation for hot metal with a scrap-melting electric furnace seems to give the best combination of low operating costs, low installation cost, and

[16] Walter Isard and John H. Cumberland: "New England as a Possible Location for an Integrated Iron and Steel Works," *Econ. Geogr.*, Vol. 26, 1950, pp. 245–259. The authors point out that market conditions, not the supply of materials, militate against such a site.

[17] M. Gardner Clark: *The Economics of Soviet Steel*, Harvard University Press, 1956, pp. 200–201.

[18] *Bulletin from the European Community for Coal and Steel*, January, 1957, pp. 3–4.

[19] *Survey of World Iron Ore Resources*, United Nations, Department of Economic and Social Affairs, 1955, pp. 152–9.

[20] H. Malzacher and R. Walzel: "Oxygen Steelmaking," *Iron Age*, 1953, p. 127.

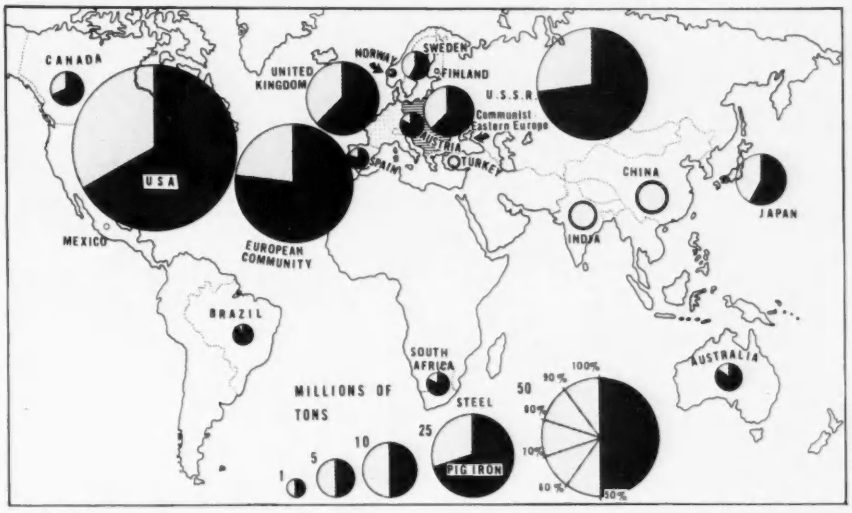

FIG. 4. Ratio of scrap consumption to steel production in the world, 1955. In India and China the volume of pig iron production exceeds that of steel.

flexibility of operation."[21] In this context it is certain that it does not pay to transport scrap long distances overland. This is shown in the fact that scrap prices commonly rule $10 a ton cheaper in New England than in Pittsburgh.

In the Duplex method the refining of the pig iron is commenced in a converter, where the carbon, silicon, and manganese are burned off, and finished in an open-hearth, which eliminates the phosphorus. It permits a high quality steel to be made from high-phosphorus iron and it also enables the open-hearth to be operated without the use of scrap.[22] It is used when scrap is scarce, and has become the established practice at the Ensley works of the United States Steel Corporation at Birmingham, Alabama. The scrap generated at this plant is disposed of to the neighboring Fairfield works of the same company, which operates only open-hearth furnaces for steel making. The home scrap of the two plants together satisfies the normal needs of the Fairfield steel works.[23]

The distribution over the world as a whole of scrap production is extremely difficult to determine. It is not even possible to obtain an accurate and detailed picture of world trade in scrap, since in some countries figures for scrap are not separately published but are included with ores or other metals. The smaller producers of scrap are also the most irregular. For instance, the island of Réunion was for a short time a considerable exporter, owing to the modernization of its sugar equipment. Among the more important producers and users of steel, the pattern is clearer,

[21] Quoted in *Survey of World Iron Ore Resources*, United Nations; see also *A Study of the Iron and Steel Industry in Latin America*, Vol. I, "Report on the Meeting of the Expert Working Group held at Bogota," United Nations, 1954, pp. 92–105.

[22] *The Making, Shaping and Treating of Steel*, pp. 359–365.

[23] H. H. Chapman and others: *The Iron and Steel Industries of the South*, University of Alabama, 1953, pp. 69–72; based also on information obtained at the works.

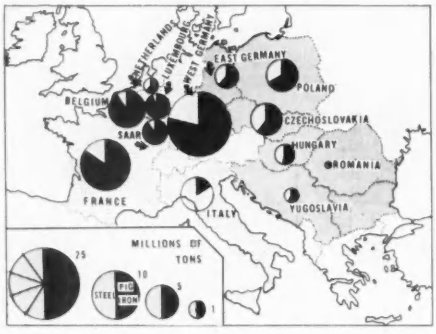

FIG. 5. Ratio of scrap consumption to steel production in the European Coal and Steel Community and in Communist Eastern Europe. Symbols as for Figure 4.

and it is fairly easy to see where scrap is generated in excess of local demand.

WORLD PATTERN OF SCRAP CONSUMPTION

It is not wholly accurate to say that the difference between the total amount of pig iron production and of steel production is made up by the use of scrap. Some pig iron goes directly to foundries, and some metal is lost to the slag during the steelmaking process. Nevertheless, the error is a small one, and by taking these two sets of figures we can gain a general picture of the distribution of world consumption of scrap. In this sense, then, the maps, Figures 4 and 5, show diagrammatically the relationship between pig iron and scrap consumption.

It becomes apparent that in the ratio of pig iron (and therefore of scrap) consumption to steel production there is a very great range, from China and India, where pig iron production greatly exceeds that of steel, to Italy where less than a fifth of the steel production is based on pig iron. The countries thus illustrated can be divided rather arbitrarily into four groups according to the ratio of scrap to steel production.[24] The asterisks indicate estimates.

1. *Over 75 per cent:* Denmark, Finland, Italy, Switzerland.[25]
2. *40 to 75 per cent:* Canada, Hungary,* Japan, Mexico, Norway, Sweden, United Kingdom, United States.
3. *25 to 40 per cent:* Australia, Austria, Czechoslovakia,[26] France, West Germany,[27] Greece,* Netherlands, Poland,[28] Romania,* South Africa, Spain, U.S.S.R.,[29] Yugoslavia.
4. *Under 25 per cent:* Argentina,* Belgium, Brazil,* Chile,* Luxembourg, Saar, India, China, Turkey.

The first group is made up of countries, such as Italy (Fig. 6), in which the raw materials for the iron-smelting industry occur only in small and inadequate quantities, and in which the steel industry is based on the use of scrap. So high a scrap ratio has, of course, to be supplied in part by imports (see below), and there is also in some instances a small import of pig iron. In each of the countries of this group, with the exception of Hungary, there is an important production of electric steel, which is refined almost exclusively from scrap. Some countries—Switzerland and Finland among them—have very small steel industries, based mainly on the use of scrap which is refined electrically.

[24] Based mainly on statistics of scrap use prepared by the British Iron and Steel Federation. Where figures are available for the use of scrap in the blast-furnace, these have been included in the totals. In so far as it is possible to judge, scrap used for foundry purposes has been excluded.

[25] Switzerland uses mainly imported high-quality pig iron and is thus an exception to the rest of this group.

[26] *Statistická Ročenka Republiky Československé*, Prague, 1957.

[27] *Iron and Coal Trades Review*, Vol. 174, 1957, pp. 1271–1272.

[28] J. M. Montias: "The Polish Iron and Steel Industry," *The American Slavic and East European Review*, Vol. 16, 1957, p. 314.

[29] M. Gardner Clark, *op. cit.*, p. 191.

The second group contains those industrially developed countries in which there is a relatively large production of domestic scrap, both process and obsolete. The generation of scrap depends both on the time during which metal-making and using industries have been in existence and on the types of metal-using industries carried on. The mechanical engineering and automobile industries generate relatively very large quantities of process scrap and also give a quick return of obsolete scrap. The United States and Great Britain have such an industrial structure and a high production and consumption rate of scrap is to be expected. Czechoslovakia is in a similar relative position. Canada and the Netherlands produce less scrap themselves, but supplement domestic output with imports. Mexico and Yugoslavia are relatively large importers of scrap. Japan has in recent years passed from category A to category B with the wartime expansion of her smelting capacity.

In the third group are countries in which, with the exception of France, industry is comparatively recent. The steel-using industries are still, in general, not of the kind that generate a great deal of scrap, and the flow of obsolete scrap has not yet become large. To some extent this position is remedied by the import of scrap, but, as we shall see below, the international scrap market is especially tight. France might be expected to belong, like Great Britain and Germany, to category B. In fact, the low scrap ratio results from the very large-scale use of the basic converter for refining the high phosphorus iron obtained from Lorraine ore.

The last group is made up, on the one hand, of certain underdeveloped countries in which relatively very little scrap is available, and of Belgium, Luxembourg, and the Saar, where most

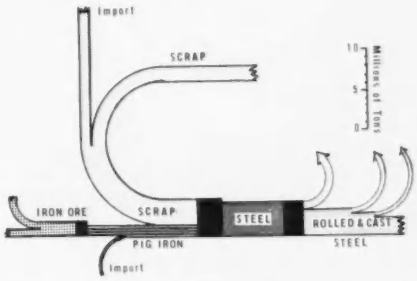

FIG. 6. Flow diagram of iron- and steel-making materials for Italy, 1955.

of the steel is made in the basic converter and only small quantities of scrap can be used. In general it may be said that countries of this group use a scrap ratio less than that normally available within an integrated works. It follows that either they export scrap, or their rolling and metal industries are not of a sufficient degree of refinement to yield this proportion of scrap.

THE PATTERN OF INTERNATIONAL TRADE IN SCRAP

This pattern is not only extremely complex, but is subject to sudden and extreme changes. This condition arises from the facts that scrap is a by-product, demand for which varies with the state of the economy; it is relatively costly to transport by land, but is carried cheaply by sea, sometimes even as ballast; and, at intervals, large consignments of obsolete scrap are made available by small countries which may not export scrap again for many years.

The preparation of a map showing the pattern of international trade is made extremely difficult by the uneven quality of the statistical sources. In some countries, the export of scrap is included with that of miscellaneous metallic ores.

Before World War II the United States and the Northwest European

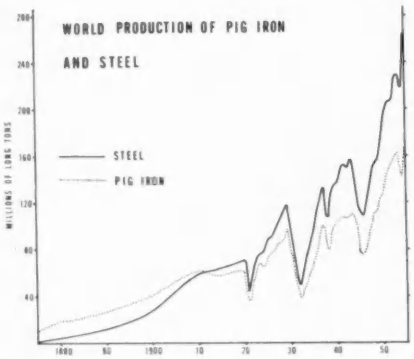

FIG. 7. World production of pig iron and steel, 1875–1955.

countries supplied about three-quarters of the scrap entering international trade. As a result of wartime demand the United States became a net importer, and remained such (except 1945–1947) until 1951, when the previous pattern of exports was resumed.[30] Indeed, the scrap export for 1956 was the largest ever reported. In the immediate post-war years, Europe became the chief source of scrap, owing to the availability of war materials, and even Japan was for a time a net exporter. But industrial expansion in Europe and Japan has since restored these areas to the position of net importers.[31]

From most countries there is a very small but fluctuating export of scrap. At present the only large-scale net exporter is the United States, followed by France.[32] The French export is due mainly to technical considerations (see above) and is quite unpredictable; that of the United States is due in part to the fact that, owing to the industrial structure and the relatively rapid capital replacement, the rate of scrap production is very high; in part because much of the scrap arises near the coast, and is more profitably sold abroad than to inland steel-making centers. A recent British report anticipated that the level of American scrap exports would decline with the increase in the production of electric steel and the location of new steel-works near the coast.

In the world as a whole there is a shortage of scrap which threatens to become serious. The graph, Figure 7, shows that since about 1915, when the world production of steel first exceeded that of iron, the gap between the two has steadily widened. This is due primarily to the increasing consumption of scrap both in the aggregate and as a fraction of the steel made. But since 1950 there has been no significant increase in the average scrap ratio, despite the fact that it is still appreciably below what is technically desirable. Two years ago O.E.E.C. reported that "the supply prospects for . . . scrap give cause for anxiety and seem more likely than any other factors to set the limit to the future expansion of steel output."[33] The mounting steel production in Western Europe, without the possibility of a commensurate increase in the quantity of scrap available, is cause for alarm, and the European Coal and Steel Community now operates a scheme whereby the Community as a whole imports scrap from outside the area and rations it among its member nations. At the same time, by means of financial inducements, it attempts to increase the production and consumption of pig iron as a substitute for scrap.[34]

[30] *Minerals Yearbook*, published annually, United States Department of the Interior, Bureau of Mines. Since 1939 this work has contained a chapter on the iron and steel scrap market.

[31] "World Trade in Scrap," *Monthly Statistical Bulletin*, British Iron and Steel Federation, Vol. 30, 1955, No. 10.

[32] *Yearbook of International Trade Statistics*, published annually, United Nations.

[33] *The Iron and Steel Industry in Europe: Trends in Economic Sector*, O.E.E.C., Paris, 1956, p. 60.

[34] *European Coal and Steel Community: Fourth General Report on the Activities of the Community*, Luxembourg, 1956, pp. 171–172.

The same problem, of course, arises in countries outside the Community, where the economies to be derived from making steel from a large admixture of scrap have to be sacrificed in favor of building blast furnaces and operating the open-hearths less efficiently on pig iron. The completion of works now planned or under construction should see a marked increase in blast-furnace capacity relative to steelworks. The increase of pig-iron capacity itself presents difficulties in countries such as Italy and Japan, where the shortage of both ore and coking coal makes them dependent on overseas sources of supply. In most countries in which the steel industry is now being developed for the first time, integrated blast furnaces and steelworks are being planned. The effect of an anticipated shortage of scrap is in general to cause an extra blast-furnace stack to be built which, in turn, greatly increases both the size of the capital investment and the problem of raw material supply.

Summary

For over half a century the utilization of scrap has played an increasingly important role in the manufacture of steel. The rolling and engineering industries produce scrap equivalent in volume to about a third of the ingot steel used, though this fraction varies with the degree of refinement of the processing industries. However much the world steel industry grows, it may be assumed that it will continue to receive this proportion of prompt industrial scrap. In most steel-making centers this scrap requires to be supplemented by obsolete scrap, the availability of which depends on steel consumption from 15 to 25 years earlier. Under stable conditions of demand and supply, obsolete scrap should be available in quantities more than adequate to meet the technical needs of the industry. Under conditions of rapidly mounting demand, this is no longer the case; scrap has become scarce, and blast-furnace capacity has to be expanded.

Scrap has little intrinsic value. Its price depends on demand and the cost of collecting, sorting and preparing it. The economies to be derived from using it, rather than pig iron, in the steel works are such that there is a strong tendency for old steel furnaces to be maintained in scrap-producing areas and for new plants to be established there.

Technological developments may be expected to influence both supply of and demand for scrap. Further improvements in rolling practice will tend to reduce the amount of process scrap available, while the expected increase in the importance of the production of electric steel will necessitate larger quantities of scrap. While the converter can take only very small quantities of scrap, the use of the oxygen lance will increase this demand. It is too early however to say what effect the use of oxygen in steel making is likely to have on the balance between converter and open-hearth and thus on the demand for scrap.

Obsolete scrap bridges the gap between the amount of prompt industrial scrap that is available and the needs of the steel industry. Its price reflects the demand for steel. Its cost of transport is relatively high by land, but cheap by water. This, coupled with the fact that large quantities of obsolete scrap arise in countries where there is no demand for it from local industries, leads to a considerable international movement of scrap, especially by sea.

Lastly, the use of scrap diminishes greatly the demand for iron ore and coking coal. These are severely limited

in quantity, and some formerly important sources are now depleted. The conservation—which in this context means the carefully planned use—of these resources is essential for the well being of future generations. The most effective way of conserving iron ore and fuel lies in the recovery of all the scrap that is economically possible and its reuse at the earliest possible moment. By shortening the life cycle of metal, its effective quantity is increased.

POST-WAR AGRICULTURAL SETTLEMENT IN MANITOBA

Burke G. Vanderhill

Dr. Vanderhill is Associate Professor of Geography at the Florida State University. The present study is an outgrowth of research on settlement in the forest lands of the Prairie Provinces which led to the Ph.D. at the University of Michigan in 1956.

THE Canadian province of Manitoba shares with her sister provinces, Saskatchewan, Alberta, and British Columbia, a zone of active agricultural settlement that extends in a great arc from the Lake of the Woods westward to the foothills of the Rocky Mountains. This "pioneer fringe" is located within the southern margin of the Boreal Forest, which forms a broad belt across the North American continent from Alaska to Labrador. Since World War II, a considerable amount of virgin land has been settled under provincial supervision and with both provincial and Dominion assistance in various forms. A particularly striking feature of the post-war period has been the placement of Canadian war veterans on Crown lands within the frontier zone under the terms of the Veterans Land Act of 1942. In addition to the demand for land on the part of veterans, there has been a need to provide low-priced land for the sons of Canadian farmers faced with increasingly high land values in the settled portions of the country.

Recent agricultural settlement in Manitoba must be investigated within the framework of provincial land policy, for nearly all of the virgin land available to prospective farmers is Crown land: that is, publicly-owned land whose title rests in the provincial government. Only a scattering of private holdings remained unsettled by the time of the Second World War, mainly Hudson's Bay Company lands with little agricultural potential. Most of the latter have been sold since 1945 to timber operators rather than to pioneer farmers. The present study, therefore, is concerned with post-war settlement of Crown lands in Manitoba and with the policy of the provincial government with respect to such settlement.

Crown Land and Land Policy

At first glance it would appear that Manitoba was well endowed with settlement land within her vast territorial holdings, for there were nearly 110,000,000 acres of forested Crown land under her administration at the close of the war. Much of this land, however, lay within the rocky Canadian Shield where only a few miniscule pockets of productive soils occur. A large proportion of the remainder had poor stony or sandy soils, podsolic in character, associated with the shorelines of the now-vanished Lake Agassiz of glacial times or with the deltas of rivers which fed that body of water. It was estimated that only about 3,000,000 acres offered the possibility of agricultural settlement, and much of that was wet land which would require costly drainage work to prepare it for entry.[1] The necessity for rather close provincial

[1] R. W. Gyles, Director of Lands, Province of Manitoba; interview, June, 1950.

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control over and participation in settlement is obvious.

Manitoba faced the post-war period with a well conceived land settlement policy which was based upon sad experience. A good deal of the pioneer settlement within the forest lands of the province prior to the war had been of a trial-and-error nature, with resulting problems of low living levels, tax delinquency, and land abandonment. These problems had been particularly critical in the mid-lake area between Lake Winnipeg and Lake Manitoba. There was the precedent, also, of the Soldier Settlement Act of World War I days and the many mistakes made in carrying out its provisions. The war-induced moratorium in settlement activities gave provincial authorities time in which to develop a land policy for the years immediately following the end of hostilities.

Essentially, Manitoba's land policy involves strict control over the settlement of Crown lands. Settlement is permitted only within those areas deemed presently suitable for farming by virtue of their soils, relief, location, and accessibility. Most settlers have been concentrated in a limited number of settlement blocks where roads, schools, churches, communications, and other social amenities could be made available. Others have been allowed to take up land on the margins of older agricultural areas, or to fill in incompletely settled areas. The objective is to allow settlement to proceed in an orderly, rational way, thus to increase the likelihood of success and to ease the task of local and provincial administration.

Assistance has been given to prospective settlers by both Dominion and provincial agencies. Dominion aid has been largely in the form of cash grants under the terms of the Veterans Land Act and financial assistance to those veterans who wished to take agricultural training in order to qualify for such grants. The province has handled the screening of applicants for V. L. A. grants and has assisted both veterans and non-veterans in locating land suited to their individual needs. Provincial aid has been extended through homestead loans and in the processes of draining, clearing, and breaking raw land, and in the construction of roads in pioneer areas.

The day of the free homestead is past in Manitoba. Crown lands considered suitable for agriculture are offered for sale to qualified applicants, mineral rights excluded. School lands[2] are sold only at public auction, held from time to time, but ordinary Crown lands are available for purchase by private individuals and are sold on extended terms at a reasonable rate of interest. Land prices vary according to soils, relief, and timber cover, but have ranged between four and fourteen dollars per acre, the average being about six dollars per acre. Land has been allocated in both quarter-section and half-section units.[3]

In view of the relative scarcity of settlement land in Manitoba, the provincial government had in 1941 reserved all Crown lands for veterans of World War II. This restriction remained in force until 1948, when the peak of the veterans' demand had passed. Veterans enjoyed a priority, however, until January 2, 1950.

Since 1948, the conditions of sale have been essentially financial. Prospective settlers have been required to show

[2] School lands are those lands set aside by the Dominion Lands Act of 1872 as an endowment for schools, proceeds from their sale being invested and interest allocated to school purposes. Sections 11 and 29 in each surveyor's township were designated as school lands.

[3] Crown and school lands are also available for use on the basis of Crop Share Leases and Hay and Grazing Permits, and Grazing Leases are considered on tracts in excess of 650 acres.

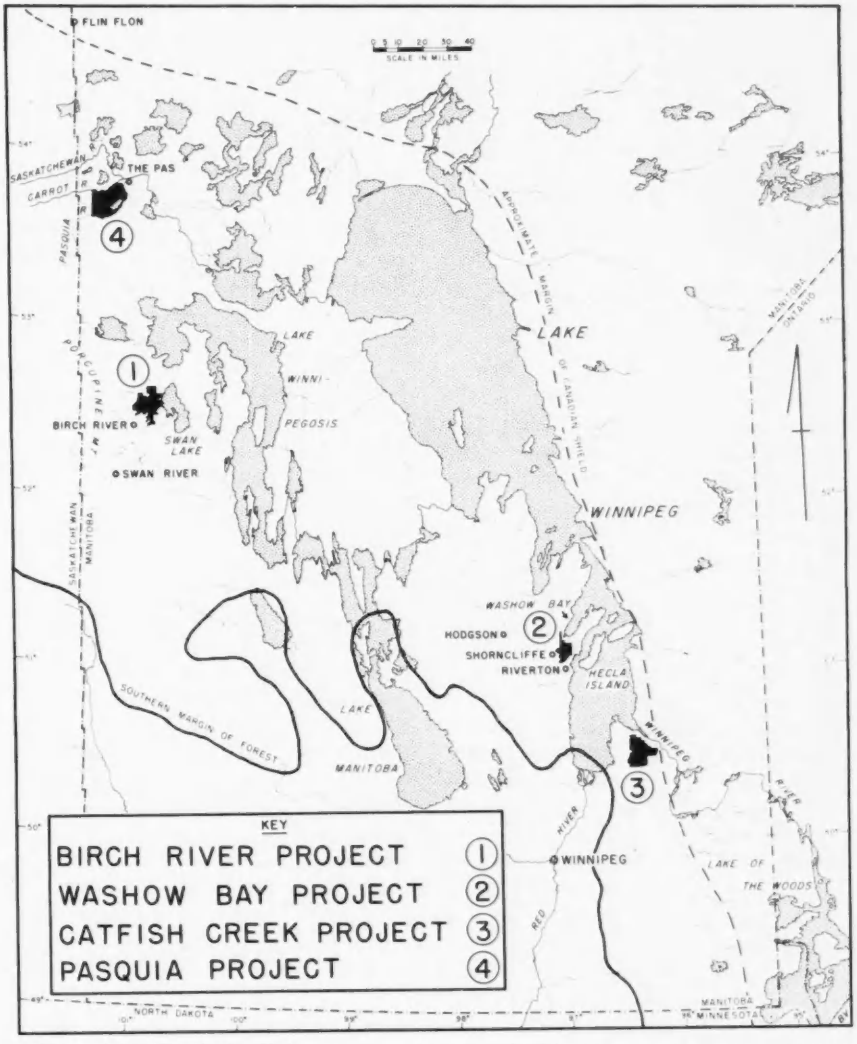

FIG. 1. Since World War II four government sponsored settlement projects have been initiated in Manitoba.

evidence of ability to pay for and operate up to a maximum of 320 acres of land and to secure sufficient power equipment for that task. There are no limitations as to place of origin, race, or religion in Manitoba settlement policy. Veterans who apply for land under the terms of the Veterans Land Act are subject to the special requirements of that act which stipulate that applicants must be screened for farm background and experience or equivalent formal agricultural training. The V. L. A. grants are in the amount of $2320 to enable veterans to make down payments on land and to provide themselves with housing and

basic equipment. Veterans may pay 10 per cent down and the remainder in twelve annual installments, while others must pay 20 per cent down and the rest in seven years.

The suitability of land for agricultural settlement is adjusted on the basis of provincial appraisal. When a prospective settler makes application for Crown land, his request is reviewed by the provincial Land Board, composed of the Director of Lands, the Director of Forestry, and the Director of Surveys; thereupon the local Land Inspector is asked to determine whether or not the land in question is fit for settlement. He is assisted by a Soils Engineer who either makes a preliminary soil survey or reviews what is known of the soils. Ordinarily, applications for land beyond the margins of existing farming areas are not honored.

Manitoba authorities are convinced that block settlement—the concentration of new settlers in limited areas or blocks of land—is the most desirable method of opening new land. Since much of the available Crown land of the province requires drainage, block settlement implies planned settlement in government-sponsored projects where drainage works, colonization roads, and other facilities are provided prior to entry. Since the war, four such land settlement projects have been under development, the total area involved comprising nearly 237,000 acres. It is expected that about 900 families ultimately will be settled in these blocks (Fig. 1). The significant features of each of the settlement projects will be discussed below, with special emphasis upon the Birch River Project as a type example.

THE BIRCH RIVER PROJECT

The Birch River Project was initiated in September of 1946 solely for veterans of World War II, and a tract of slightly more than 40,000 acres was set aside for this purpose in the lowlands between Lake Winnipegosis and the base of the Manitoba Escarpment. The project area has since been expanded to 54,991 acres. The first non-veterans were admitted in 1949, and since 1950 most of the new settlers have been in that category.

Preliminary to the development of the project was a soils survey of the area, followed by a land survey. The area was essentially a swamp; indeed, the northwestern portion was called Novra Swamp, and was covered with tamarack, cedar, and black spruce. This poorly drained area slopes almost imperceptibly from the base of Porcupine Mountain—a segment of the Manitoba Escarpment—eastward to the shores of Swan Lake, which drains to near-by Lake Winnipegosis. The chief irregularities of the nearly level surface are provided by low gravelly or sandy knobs and ridges which are shoreline remnants of glacial Lake Agassiz. The productive soils include clay and silty loams with a high percentage of organic matter, and some areas of muck soils.

Once the surveys were complete, actual development of the area began. Drainage was the prime requisite, but was to be accomplished as a corollary of road construction. As roads were cut and graded, ditches eight to ten feet in depth were installed along the sides, providing channels for current run-off and at the same time the means for lowering the ground water levels in the adjacent lands (Fig. 2). Since 1946, over 200 miles of colonization roads and drains have been constructed and 225 bridges have been built. Less than 100 miles of the roads, however, have been opened for use.

The work was done by crews under contract to the provincial government,

operating out of a headquarters camp centrally located within the project. The camp consisted of a number of portable buildings on skids which served as project offices, dormitories, kitchen and dining hall, storage warehouses, and maintenance shops. The need for the camp was past by 1956, and the equipment and machinery has been sold on bids.

As the work of road construction and drainage progressed, cutting of timber and clearing of land began, followed by rough breaking in many instances. About 50 acres per quarter-section has been broken, much of it by project crews. In such cases, the costs have been added to the price of land when sold. New settlers may do their own clearing and breaking if they so desire, but few of them have done so. Large bulldozers have been used to cut off small timber or to push over larger trees and to pile them up in long windrows about 60 yards apart for burning. This arrangement leaves sufficient open space for breaking before the debris of burning is removed; in fact, often the first crop has been sown and harvested before the debris has been entirely cleared away. The newly-broken land has been dragged and leveled before transfer to the new settlers.

Sales of land began with the first road construction, but actual settlement lagged, most of it coming after 1948. By 1949, however, there were enough settlers to warrant the erection of a school along the main road within the project. Until April of 1949, only veterans were allowed to purchase land in the project. They bought mainly south of the headquarters camp, so that today about 75 per cent of the settlers in the southern half of the project are veterans. After the spring of 1949, non-veterans began to take up land, mainly north of the project headquarters. Only about 40 per cent of the settlers in the northern half of the project, consequently, are veterans. A great many of the settlers came from Saskatchewan; in fact, 90 per cent of those arriving since 1948 have come from that province. Frequency of drought and a shortage of settlement land in Saskatchewan seem to be the main factors involved, although there are some indications of dissatisfaction with the political regime there.

FIG. 2. Drainage ditch along colonization road in Birch River Project. The graded road is at right. Swamp vegetation is in evidence in the distance.

The price of land within the project varies with clearing costs, soil quality, and location, but usually ranges from $1700 to $2500 per quarter-section. A settler is limited to a maximum of 320 acres in his own name. Some circumvent this restriction by purchase of additional land in the name of members of their families.

The example of two brothers from Saskatchewan will illustrate the foregoing practice and typical settlement processes as well. The two brothers, in their late teens, came to the Birch River Project in the spring of 1950 to seek land. Their stated reason for coming here was that there was no land at home at a reasonable price. They purchased adjoining half-sections, thus securing a 640-acre block at the outset. Their father and an aunt arrived later and purchased a half-section and a

FIG. 3 (left). Farmstead at Birch River Project in early stage of development, 1950. The small, portable shack served as the initial dwelling, then was replaced by the granary in the background. The mud is typical of pioneer farming areas.

FIG. 4 (right). Farmstead at Birch River Project in first year of farming operations, 1950. Two rooms have been added to the original cabin hauled here on skids the previous year. Note piles of debris remaining in field of oats, the first crop, in middle distance. The spruce-tamarack complex of Novra Swamp is evident in background.

quarter-section, respectively, near by. Thus the brothers had at their disposal about 1120 acres of land for combined operations.

The first step in the process of occupying the land in this case was to establish residence. A home-made house trailer served the purpose at first, but by the middle of the summer of 1950 a granary had been completed and had been converted to temporary use as a dwelling (Fig. 3). The work planned for the remainder of that year included the construction of two or three additional granaries and the harrowing, root-picking, and disking of a part of their cleared land. The first crop was to be sown in the spring of 1951. The brothers planned to raise Redman wheat and Clinton oats, and some flax on the rockier land. After spring seeding, more land was to be cleared and broken. The third year, 1952, was to see a well driven and some permanent buildings erected. The boys planned to live and work together for the first few years.

Other settlers have followed somewhat similar patterns of development on their lands. A number of them have constructed one-room cabins in near-by Birch River village and have hauled these to their homesites on log skids, subsequently building on additional rooms (Fig. 4). The crops are generally wheat, oats, and barley, in that order of importance, oats often being used as the starter crop. The first years of settlement usually witness the development of large gardens and the cutting of poles for fencing. The clearing and breaking of additional land requires much of the new farmer's time. It is far from an easy life, but most contemporary pioneers are better off than their predecessors of pre-war days.

An unusual feature of the Birch River Project is its community pasture. Comprising 4128 acres in the western portion of the project area, the pasture has a capacity of approximately 500 head of stock. Its purpose was to provide grazing land for the project settlers, but demands for pasturage to date have been so light that summer grazing rights have been leased to farmers outside of the project. When the project residents have built up their herds, they will have exclusive access to the pasture. It is under careful supervision, and all stock is treated for warbles and blackleg before being admitted.

Settlement in the Birch River Project

is not yet complete. The peak demand was during the years 1949–1951, and the number of new entries has declined rapidly since that time. By mid-1956 there were 163 farming units settled, while 43 units remained available for immediate sale. Additional land will be made available when the demand warrants the necessary road and drain work. There has been no land abandonment to date. While excessive rains in 1950 and again in 1955 threatened the success of the area, settlers remained on their lands. The provincial government assisted them by granting a considerable number of 20-year extensions on the purchase contracts, thus reducing the annual payments. The roads, graded but not surfaced, are sometimes impassable and never very satisfactory, and farmyards are frequently quagmires; but the new farmers have accepted the conditions of the area, hoping for improvements and refinements later.

THE WASHOW BAY PROJECT

The Washow Bay Project was established in 1949 in the poorly drained lands southwest of Washow Bay, an arm of Lake Winnipeg. The original project area comprised 18,800 acres of marsh and swamp land whose dark organic soils offered the possibility of good crop yields when adequately drained. By 1956, after several boundary changes, the project included 49,040 acres of such land between the railhead town of Riverton and Washow Bay.

The drainage problems were more difficult here than in the Birch River area because of the extreme flatness of the surface and its lowness with reference to the varying levels of Lake Winnipeg. In addition to the construction of ditches along the colonization roads, it was necessary to build a retaining dike along Washow Bay, to prevent its overflow into the project area, and a network of deep drainage ditches throughout the settlement block. Drainage has been done by the Public Works Department of the provincial Lands Branch, and the cost is amortized over a period of about 20 years by means of a drainage tax.

Settlement in the Washow Bay Project was slow at first. Perhaps the history of land abandonment in the mid-lake area worked against post-war interest in settling there, coupled with local familiarity with the waterlogged nature of the area. In any case, most of the early settlers were local veterans, many of them descended from the Icelandic immigrants of the last century who colonized the western borders of Lake Winnipeg. During the first year of the project, 1949, the system of veteran preference was in force. Non-veterans could purchase land by means of sealed bids, but could not bid against veterans. Since January 2, 1950, however, all lands have been sold, on bids, without preference. The reserve price established by the provincial land authorities has varied between $1100 and $2150 per quarter-section, and most land has been sold in half-section units. Much of the initial settlement was near the community of Shorncliffe, but since 1950 most newcomers have purchased land along or near the Riverton—Washow Bay road, within easy reach of the town and its rail facilities. A Mennonite colony seems to be developing there, for most of the recent sales have been to such bidders. By 1956, there had been 111 entries, and there were 17 units of land immediately available for entry. Additional areas will be made available by ditching and road construction when a demand materializes. It is expected that the Washow Bay Project will accommodate about 250 families when settlement is complete.

THE CATFISH CREEK PROJECT

The Catfish Creek Project is located about 60 miles northeast of Winnipeg in a wet area south of the Traverse Bay arm of Lake Winnipeg and the lower course of the Winnipeg River. Catfish Creek flows in a course roughly parallel to the Winnipeg River and west of it. Nearly 34,000 acres were set aside as a settlement project in 1947, and the area has been increased since that time to 82,474 acres. Nearly all of the area was a peat bog, with one to four feet of peat overlying clays. The development of the area has required the draining and burning-off of the peat, after which the ashes are plowed into the clay substrata. The result is a fairly productive clay loam. Clearing costs are at a minimum, for much of the bogland was not forested, although surrounded by timberland.

A limited settlement had taken place here considerably before the provincial project came into being. A few families of French-Canadians had squatted on these Crown lands as early as 1940, without official sanction. When the provincial Lands Branch began its preliminary surveys after the war, the squatters presented an administrative problem. Through arrangements with their local priest, however, the province was able to make their status official by selling them the lands which they were occupying.

Since the establishment of the project, most of the land sales have been to sons of Ukrainian and German farmers of the more heavily settled portions of Manitoba where land prices are high. Thus second-generation Canadians predominate in the Catfish Creek area. There seems to have been, however, an attempt on the part of the Catholic Church authorities to create a parish of French-Canadians here. The original provincial plan called for the settlement of about 300 families by 1953. The estimate was scaled down to about 150. By 1956, 118 families had found land within the project, while 21 additional land units were available for immediate entry. Sales here, as in the Washow Bay area, are based upon sealed bids, and the reserve prices have varied between $800 and $2100 per quarter-section. Nearly all of the land has been sold in quarter-section units.

THE PASQUIA PROJECT

The Pasquia Project, until recently known as the Carrot River Project, is unique among Manitoba's settlement projects from several standpoints. The project area comprises a marshy tract of nearly 50,000 acres southwest of The Pas and south of the Saskatchewan River near the western boundary of Manitoba. Tributaries of the Saskatchewan, the Carrot River on the north and the Pasquia River on the south, form the boundaries of the settlement block. The land settlement project is a part of a larger flood control and reclamation project for the The Pas area. The project lies 100 miles beyond the margin of continuously settled agricultural land, and the problems facing settlement are so critical that the province retains title to all lands within the block, merely leasing them to prospective farmers.

The site of the Pasquia Project is a part of the delta of the Saskatchewan River and has long been considered potentially valuable as farmland, for the organic soils of the interfluvial marshes have been enriched by silt deposited during periods of high water. As early as 1913, the Dominion government established a Pasquia Reclamation Project here, and investigations of the delta area were carried out preparatory to drawing up plans for flood control and

land reclamation. World War I intervened, and work was not resumed. Just prior to World War II, there was a renewal of official interest in this area, and the Carrot River Project was initiated. After the war time cessation of effort, the Prairie Farm Rehabilitation Administration, a Dominion Agency, began conduction surveys of potential farmlands west of The Pas, with an eye to resettling people from the drought-ridden prairies to the south, and investigation work was carried out by both federal and provincial agencies to determine the possibilities of protecting the area from future flooding. During this period the project was opened to limited entry.

The Pasquia block offers productive soils requiring little or no clearing of timber. The growing mining centers on the Canadian Shield to the north, particularly Flin Flon, provide a market for such products as milk, eggs, butter, and vegetables. A grain elevator constructed in The Pas in 1948 gave impetus to the growing of oats and barley. The frost-free season averages about 100 days, and rainfall during the summer season is usually adequate.

On the other side of the ledger are the problems which confront the pioneer farmer in the Pasquia area. Foremost among them is flooding. The project was entirely flooded in the summer of 1948, and most of the crops were again destroyed by high waters in 1951. After the flood of 1948, ponded water remained in the lower spots necessitating a drainage program. The program is still in progress. It is the danger of recurring floods which has led the provincial government to the policy of leasing rather than selling land within the project. The policy is to remain in force until permanency of settlement is assured by flood control work.

There are several lesser problems. The frost dates are rather variable in this northern area. Dairy herds are troubled by huge caribou flies during a part of the summer, and attacks by timber wolves are not unknown. One of the great continental flyways of migratory waterfowl crosses the Saskatchewan Delta, and, to the distress of local farmers, the ripening grain of the area provides the first stopping place for many flocks heading south for the winter.

Despite the problems, a large proportion of the project land has been taken up in the post-war years. Prior to the 1948 flood, about 80 lessees had settled within the Pasquia block. Driven out by the flood waters, many of them returned to their leaseholds when the waters subsided. By 1951, the number of leaseholds was nearly back to the pre-flood level, and by 1956 there were 40,324 acres rented under 130 leases and permits. The lower portions of the project have never been reoccupied, and ponds remain here and there. Many of the lessees have come from the drought-prone areas of Saskatchewan and Alberta, others from various parts of Canada where land values are prohibitive. General farming is the rule here, with dairying an important adjunct. Crops include oats, barley, flax, potatoes, and vegetables, and much hay is produced, some of it baled for shipment.

OTHER SETTLEMENT

While the Manitoba government has been most concerned with the progress of settlement within the various projects, individual entries have been made all across the pioneer zone since the war. Particularly important in this has been the acquisition of Crown land by sons of local farmers. These were veterans in the first years after the war, because of the restrictive policy of the province, but non-veterans have pre-

dominated since 1950. In addition, many young men from Saskatchewan have found land in Manitoba, especially in the Swan River area not far from the Saskatchewan line.

Even in the mid-lake area, where abandonment had been so widespread during the pre-war period, new settlement has been taking place. The construction of a wheat elevator in the railhead town of Hodgson in 1949, for example, provided a stimulus to the opening of new land in the vicinity. The sons of Icelandic fishermen-farmers of Hecla Island and of the western shores of Lake Winnipeg have been purchasing scattered tracts of Crown lands near their family homes. High wheat prices in the post-war years have been important, too, in stimulating land purchase in the mid-lake area. The permanency of such settlement is not assured, however.

TRENDS IN SETTLEMENT

It is interesting to note that there is a tendency for groups of people of similar racial or cultural background to cluster within the blocks of Crown land opened to settlement. This was not the intent of the provincial authorities, for there is a feeling among them that such groups are difficult to assimilate into the population, that they constitute an irritant in Manitoba society. The province has made no provision for the settlement of groups of displaced persons or other refugees from Europe, for example, although a few have been settled as individuals on Crown lands. There is nothing in the official policy, however, to prevent people of the same racial or religious origins from applying for a number of adjoining units of land. This they are doing.

The task now facing the land administrators of Manitoba is that of maintaining an orderly development of those Crown lands which seem to be suitable for settlement. The Post War Planning Committee has designated several areas within the province as possible settlement projects, and investigations of these areas are now under way. Soil surveys carried on by the University of Manitoba and by provincial agencies are basic to such investigations and have already indicated the inadvisability of opening up some of the Crown lands under consideration. The principal areas which seem to offer an agricultural potential are marsh, swamp, and bog areas. There are several such areas on the Lake Agassiz lowlands west of lakes Manitoba and Winnipegosis, and one sizable area southwest of the Catfish Creek Project. In addition, there are a number of smaller pockets in the Canadian Shield north and northeast of Lake Winnipeg now under study. The latter are envisioned chiefly as possible adjuncts of mining or fur production in the Shield zone. It is in scattered, rather limited areas, then, that future agricultural settlement in Manitoba will take place.

GEOGRAPHY OF MANUFACTURING IN INDIA

Pradyumna P. Karan and William M. Jenkins, Jr.

Dr. Karan, Assistant Professor of Geography at the University of Kentucky, has written several articles dealing with the industrial geography of India. Mr. Jenkins is Assistant Co-ordinator of the University of Kentucky's programs of technical aid to Indonesia.

ALTHOUGH there have been numerous studies by economists on the location of major Indian industries, few geographers have seriously attempted to measure the pattern of industrial development in India from the standpoint of economic geography.[1] A pioneer work on the quantitative delimitation of the industrial regions of India was carried out by Trewartha and Verber on the basis of 1944 employment data. However, the three industrial regions outlined in their map—Northern, Western and Southern—fail to portray the true regionalism of industry. These regions include predominantly agricultural areas, and, at the same time, certain significant manufacturing areas such as the Bihar-Bengal Industrial Belt are not given separate recognition. Further, the use of figures for perennial employment without due regard to the importance of seasonal employment in such industries as tea and sugar lead Trewartha and Verber to overlook sizable industrial regions tied to the agricultural economy.

This article attempts to present in map form (a) the regionalism in Indian manufacturing and (b) the locational pattern of six major industries on the basis of 1950 employment data.

The Regional Pattern of Manufacturing

The official publication, *Large Industrial Establishments in India*, is the best available source of data for mapping the areal distribution of manufacturing in India.[2] This gives the name and location of each factory under industry groupings and indicates the average annual employment. The latest available issue, dated 1952, contains employment figures for 1950. These data have been used here in mapping the locational pattern of Indian manufacturing.

Unlike Trewartha and Verber's map in which both city and district units have been used, the authors have selected the district (comparable to the county in the United States) as the areal unit for mapping the regional pattern of Indian industry. A single unit is

[1] Only two significant monographs by economists are listed here: Tulsi Ram Sharma, *Location of Industries in India* (Bombay: Hind Kitabs Ltd., 1954); Economic Adviser to the Government of India, *The Location of Industry in India* (Delhi, 1945). The only geographic study known to the authors which attempts to outline the industrial regions of India is by two American geographers, Glenn T. Trewartha and J. L. Verber: "Regionalism in Factory Industry in India-Pakistan," *Econ. Geog.*, Vol. 27, 1951, pp. 283–286.

[2] Labor Bureau, Government of India, *Large Industrial Establishments in India, 1950*, 21st Issue (Delhi: Manager of Publications, 1952). The first 17 issues of this publication up to 1944 were published by the Commercial Intelligence and Statistics Department of the Government of India. (The data in the *Indian Census of Manufactures* is not sufficiently detailed to reflect regionalism in Indian industry and hence is not suitable for mapping purposes.)

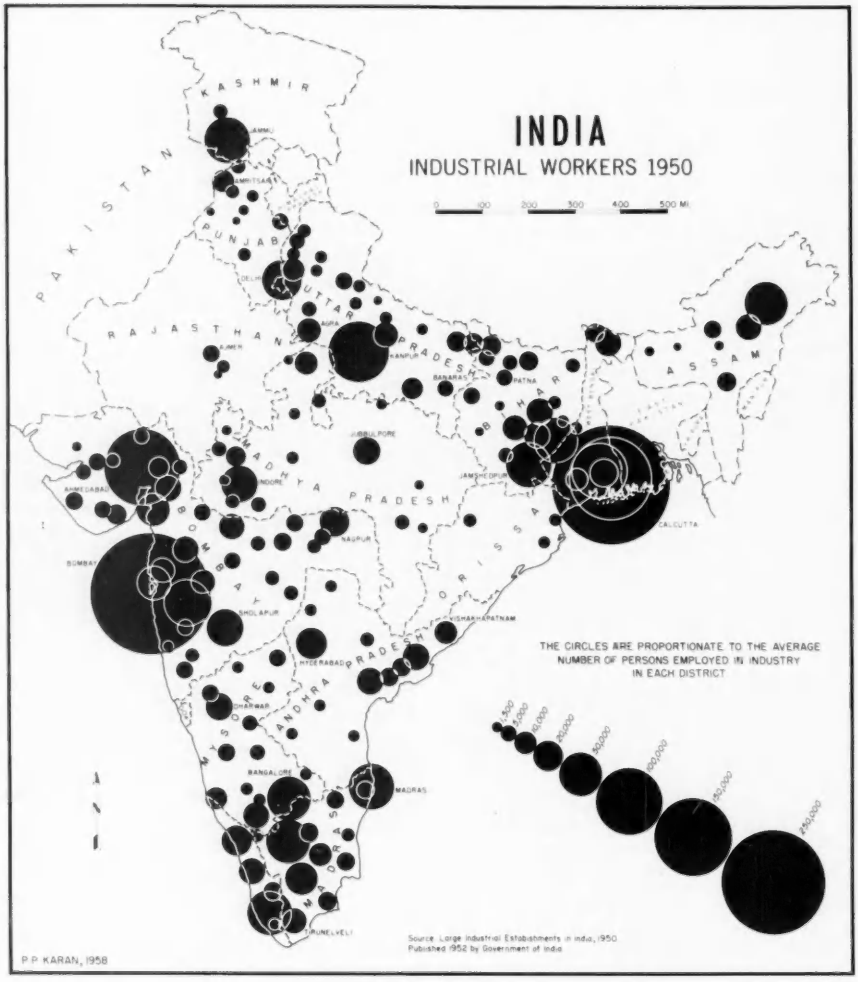

FIG. 1.

desirable and mapping on the basis of city units would result in the elimination of an important segment of Indian manufacturing enterprise located outside city "limits" and in "rural" areas. Therefore, for practical reasons, and through common usage, the district, or county, which has been widely accepted by American geographers as the basic areal unit for mapping, is used here for the construction of a map of the industrial regions of India.[3]

Districts in which 1500 or more wage earners were employed in manufacturing

[3] At least two American geographers specifically favor the use of data on a county basis for mapping manufacturing in the United States. See Clarence F. Jones: "The Areal Distribution of Manufacturing in the United States," *Econ. Geog.*, Vol. 14, 1958, pp. 217–222; and Helen M. Strong: "Regions of Manufacturing Intensity in the United States," *Annals of Assn. Amer. Geogrs.*, Vol. 27, 1957, pp. 23–93.

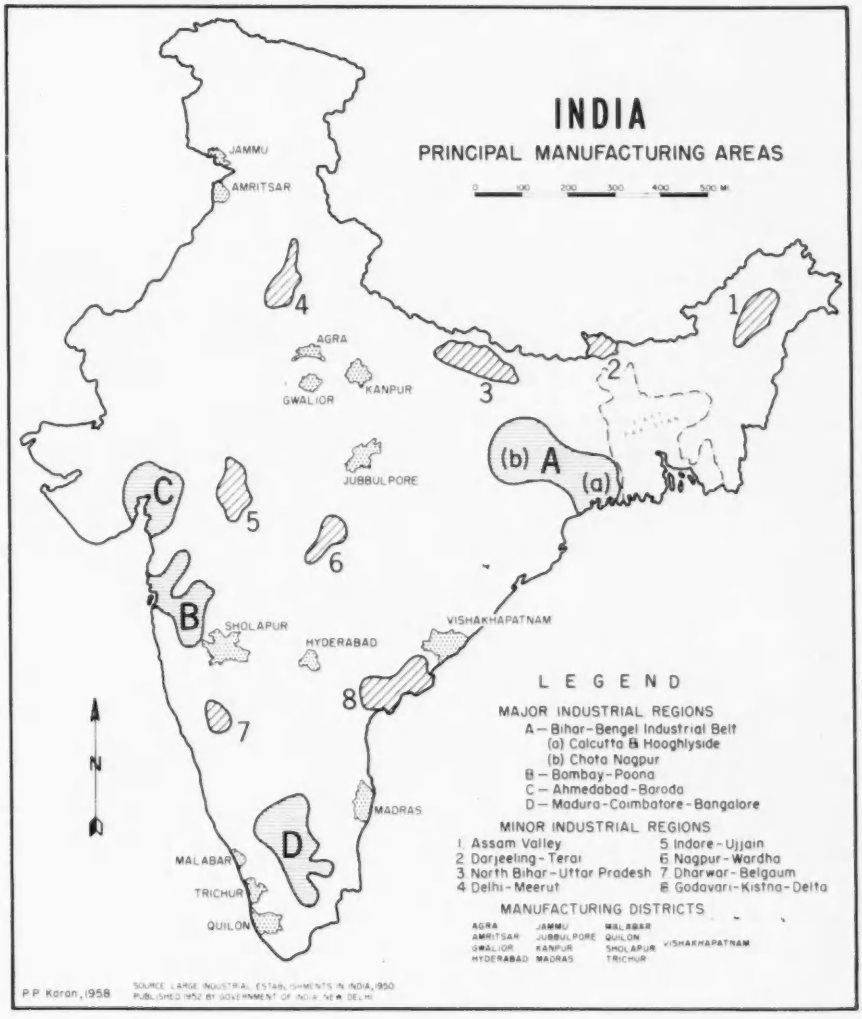

FIG. 2.

were termed industrial districts for the purposes of delimiting Indian industrial regions. This minimum, admittedly arbitrary, was selected to eliminate those districts which are essentially non-industrial despite the presence of ubiquitous industry.

The map of the distribution of industrial workers (Fig. 1) reveals four major industrial regions, eight minor regions, and 13 manufacturing areas of less significance (Fig. 2). The four major regions contain the greatest industrial concentration in India.[4] These

[4] For description of these major industrial regions see Pradyumna P. Karan: "The Areal Distribution of Manufacturing in India," *Journ. of Geog.*, Vol. 57, 1958, pp. 294–300.

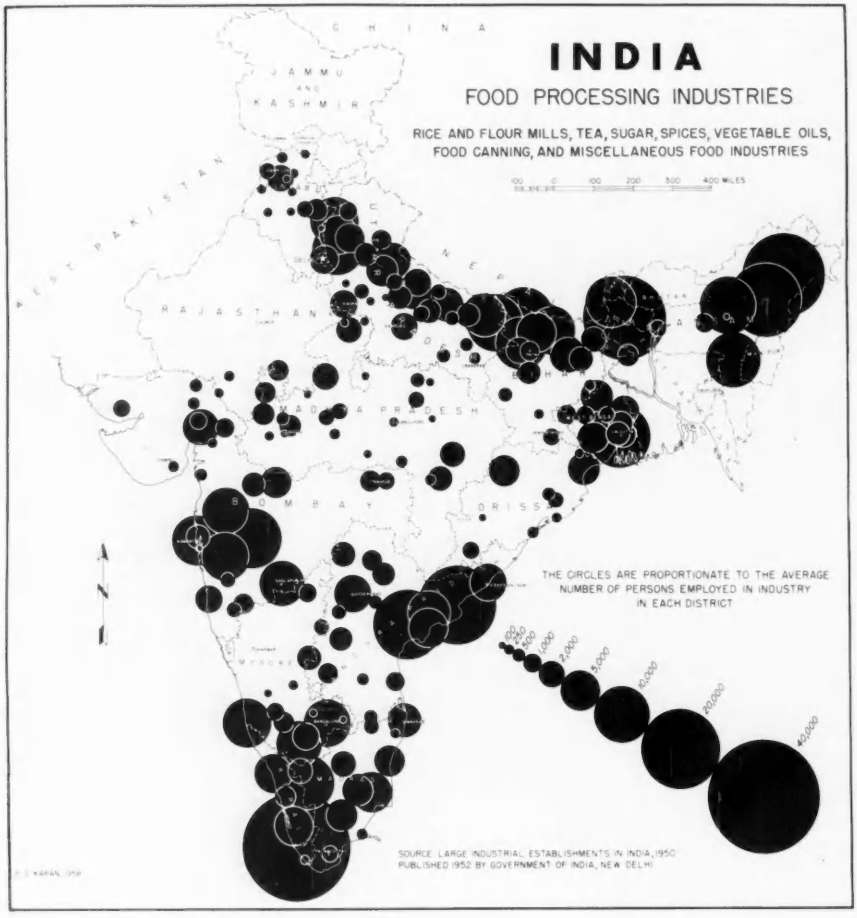

FIG. 3.

are: A. the Bihar-Bengal Industrial Belt in which the two industrial concentrations—the Chota Nagpur heavy industrial area of Bihar and those near Calcutta and along the Hooghly River in West Bengal—are separated by areas of meager manufactural activity. The belt, therefore, is divided into two subregions: (a) Calcutta and the Hooghly-side industrial strip with considerable jute, cotton, engineering, and miscellaneous industries and (b) the Chota Nagpur Heavy Industrial Area with minerals and metal industries projecting down the Damodar Valley into West Bengal; B. the Bombay Industrial Area which has important cotton textile, chemical, engineering, and miscellaneous industries; C. the Ahmedabad-Baroda Industrial Area with considerable cotton textile and chemical industries; and D. the Madura-Coimbatore-Bangalore Industrial Area with textile, clothing, and miscellaneous industries.

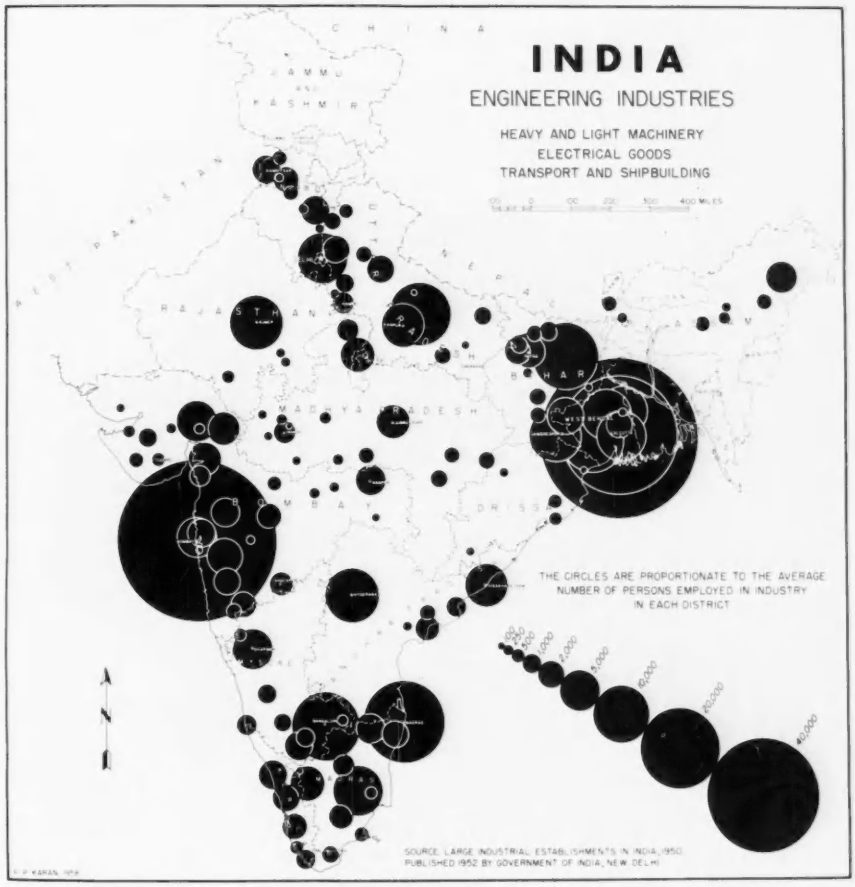
INDIA
ENGINEERING INDUSTRIES
HEAVY AND LIGHT MACHINERY
ELECTRICAL GOODS
TRANSPORT AND SHIPBUILDING
THE CIRCLES ARE PROPORTIONATE TO THE AVERAGE NUMBER OF PERSONS EMPLOYED IN INDUSTRY IN EACH DISTRICT
SOURCE: LARGE INDUSTRIAL ESTABLISHMENTS IN INDIA, 1950
PUBLISHED 1952 BY GOVERNMENT OF INDIA, NEW DELHI

FIG. 4.

The eight minor regions and their dominant industries are: (1) the Assam Valley and (2) the Darjeeling-Terai area of West Bengal—tea; (3) the North Bihar–Uttar Pradesh area—sugar; (4) the Delhi-Meerut area—textiles and general industries; (5) the Indore-Ujjain area of Malwa Plateau and (6) the Nagpur-Wardha area in Central India—cotton textiles; (7) the Dharwar-Belgaum area—miscellaneous light industries; and (8) the Godavari-Kistna Delta area of Andhra—rice milling and food processing industries.

Other manufacturing districts of lesser importance are scattered over the nation. In most of these, industry is diversified—textiles, food processing, engineering and light goods. Certain minor districts, however, are somewhat specialized: Sholapur, Kanpur, Jammu, and Hyderabad are noted for textiles; Vishakhapatnam for shipbuilding; and Jubbulpore for the government ordnance works.

LOCATIONAL PATTERNS OF SIX MAJOR INDUSTRIES

A study of the locational patterns of six major Indian industries contributes

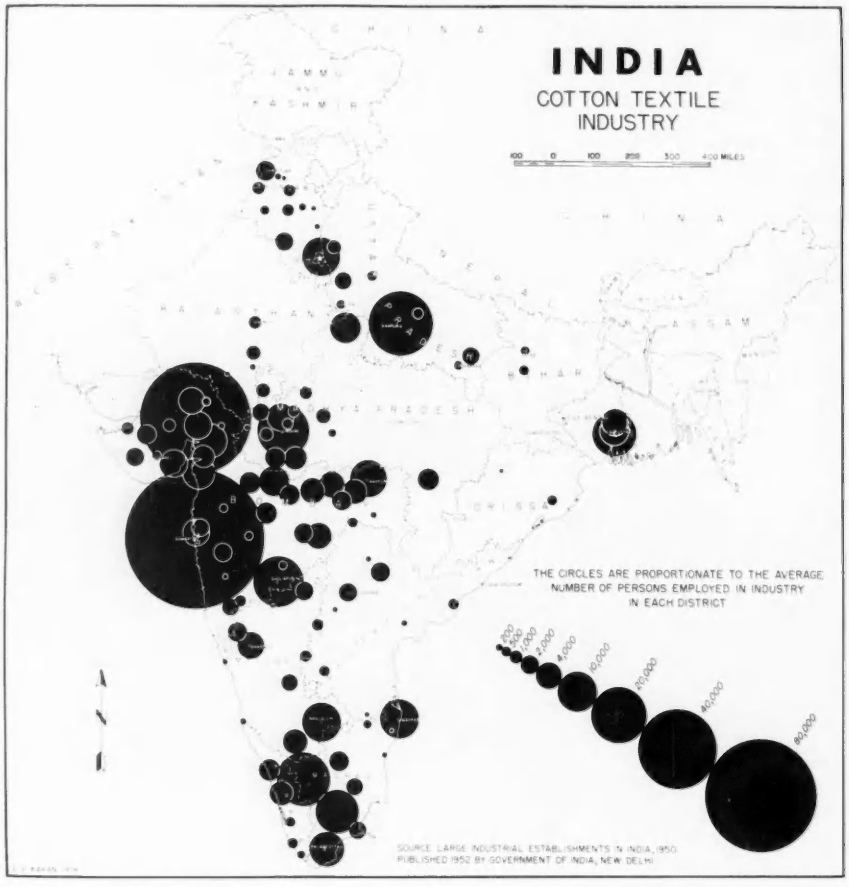

FIG. 5.

other aspects to the manufacturing picture.

Food Processing

The important centers of food processing are located within those areas in which foods are grown and thus the industry exemplifies regionalism to a considerable extent. On Figure 3 eight major areas of concentration stand out. The areas and the main product of each are: (1) the Assam Valley and (2) the Darjeeling-Terai area—tea; (3) Calcutta and the Lower Ganges Valley and (4) the Lower Godavari Valley—rice milling; (5) Bombay and surrounding area and (6) the Upper Ganges Valley including the Delhi area—flour production; (7) the Middle Ganges Valley—sugar; and (8) the Kerala—South Mysore area—condiments, spices, fish oil, and fish guano. The hilly region of Mysore also has an important coffee industry.

On the map will be noted a few other scattered industrial centers associated with the processing of food for consumption in the urban areas.

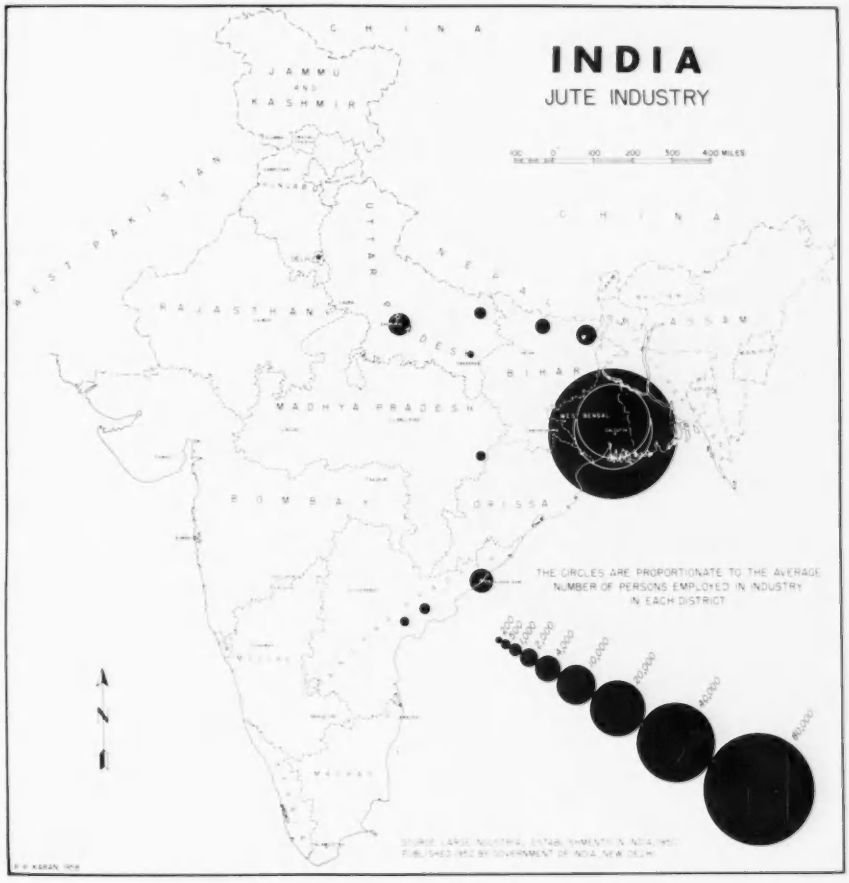

FIG. 6.

Engineering Industries[5]

Two concentrations of engineering industry can be recognized on Figure 4. The major structural steel and heavy machinery firms of India are located in the Bihar-Bengal Heavy Industrial Belt which produces most of the nation's implements, spare parts, tools, railway engines, and steel products. Bombay is the center of the electrical engineering industry as well as for the manufacture of light machines, textile machinery, and automobiles.

Other important areas include the railway repair centers of Madras, Kanpur, Delhi, and Ajmer. Jubbulpore, as has been noted, is important for its government controlled ordnance works; Bangalore has aircraft and telecommunication plants. Most of the smaller centers are engaged in the manufacture of hardware items such as screws, nuts, and bolts.

[5] For description of the engineering, chemical and metals industries see P. J. Thomas: *India's Basic Industries* (Calcutta: Orient Longmans, 1948). A more recent work is by Srinivasa Rao: *Surveys of Indian Industries*, Vol. 1 (Calcutta: Oxford University Press, 1957).

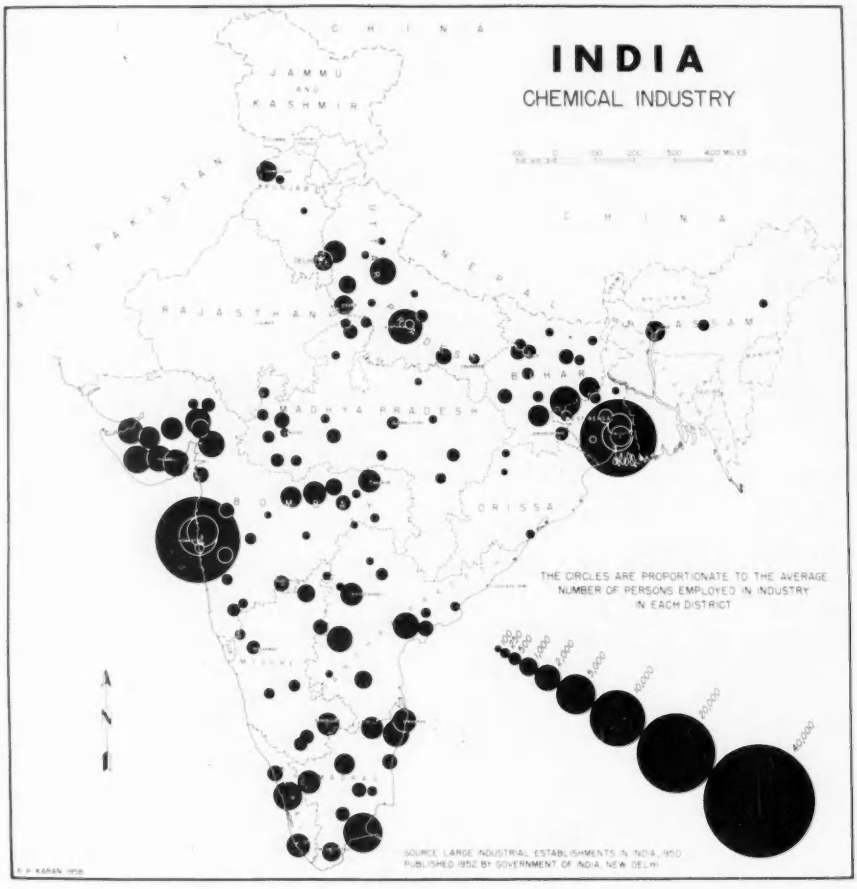

FIG. 7.

Cotton Textile Industry

India's cotton textile industry is the second largest in the world, and cotton cloth is one of the country's most important exports. The industry has developed mainly in Bombay State, especially in Bombay City and Island, and in the Ahmedabad area (Fig. 5). Bombay still leads all other states in cotton manufacturing.[6] However, the presence of a large populous home market led to a shift of the industry to the interior. This shift of the Indian cotton industry is somewhat similar to the migration of the American industry from the New England States to the South. In some instances the move in India has been to the source of raw cotton as in the case of mills at Nagpur, Sholapur, Indore-Ujjain, and Delhi. In other instances, as in that of Calcutta and Kanpur, the shift has been toward the large market.

Figure 5 indicates other areas of im-

[6] William Kirk: "The Cotton and Jute Industries of India: A Study in Concentration and Dispersal," *Scot. Geogr. Mag.*, Vol. 72, 1956, pp. 38–52.

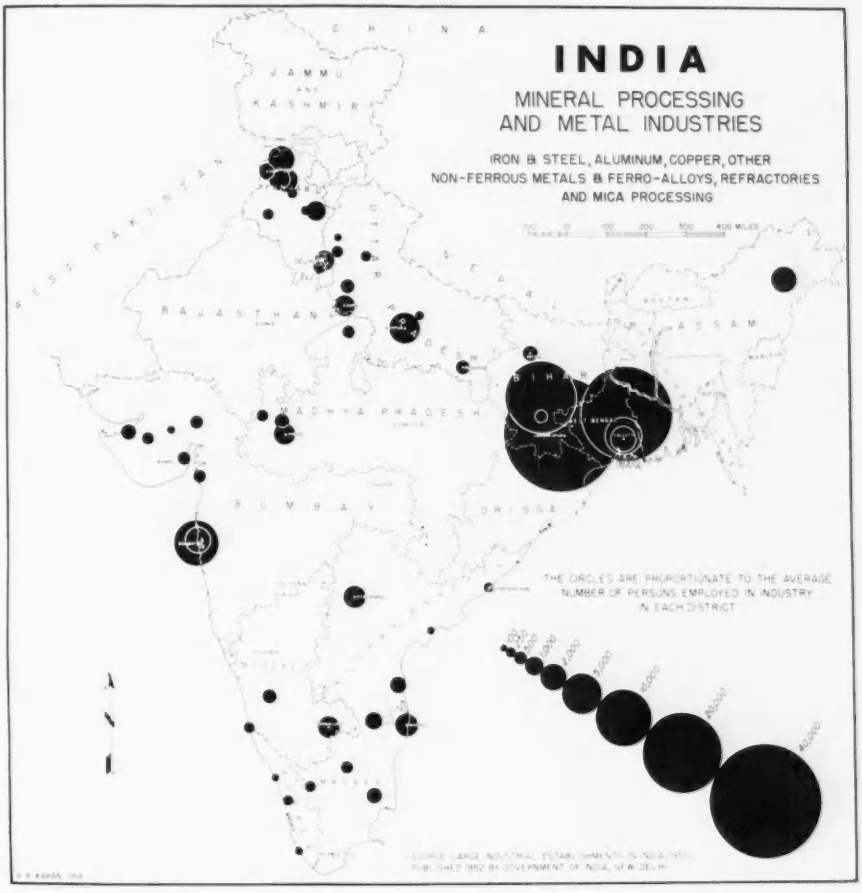

FIG. 8.

portance such as Khandesh and Berar, the Coimbatore-Madura area, Madras, and Bangalore.

Jute Industry

Jute manufacturing, which employs over three hundred thousand workers, is India's second textile industry. The majority of the more than 180 factories are located along the Hooghly River in West Bengal (Fig. 6). The port of Calcutta and the local raw material are the most important locational factors concentrating the industry along the Hooghly.[7]

Chemical Industry

Two significant regions of chemical industry stand out on Figure 7. Of these Bombay is the largest, and the industry here produces a wide variety

[7] William Kirk: "The Influence of Port-Hinterland Controls on the Location of the Cotton and Jute Manufacturing Industries of India," *Proceedings, 17th International Congress, International Geographical Union* (Washington, D. C., 1952), pp. 633–638.

of chemicals, dyes, and pharmaceutical products.

The Calcutta area produces basic chemicals such as sulphuric acid, sodium carbonate, caustic soda, and a variety of chemical products and drugs. Other areas are smaller and frequently more highly specialized. Examples of such areas are the Damodar Valley, coal tar derivatives, and Kanpur, perfumes and essential oils.

Mineral Processing and Metal Industries

Figure 8 reveals only one distinct industrial region engaged in the processing of minerals and the production of metal, the Bihar-Bengal Heavy Industrial Belt, especially the Chota Nagpur area of Bihar.[8] The important economic minerals of Bihar—coal, iron, mica, manganese, bauxite, copper, limestone, and kyanite—form the resource base of this industrial region. This area accounts for 50 to 100 per cent of the total value of the various minerals and metals produced in India.[9] Over 95 per cent of the present iron and steel production comes from this region.[10]

ACKNOWLEDGMENTS

This study was supported by the Graduate Faculty Research Fund of the University of Kentucky.

[8] For details on the regional pattern of industrial development in Chota Nagpur see Pradyumna P. Karan: "Economic Regions of Chota Nagpur, Bihar, India," *Econ. Geog.*, Vol. 29, 1953, pp. 216–250.

[9] For details see P. P. Karan: "Geography of Mineral Production and Manufacturing in Chota Nagpur, The Heavy Industrial Area of India" (Unpublished Doctoral Dissertation), Indiana University, Bloomington, Indiana, 1956.

[10] John E. Brush: "The Iron and Steel Industry in India," *Geogr. Rev.*, Vol. 42, 1952, pp. 37–55. Also see Pradyumna P. Karan: "Locational Pattern of the New Centers of the Indian Iron and Steel Industry," *Journ. of Geog.*, Vol. 56, 1957, pp. 366–379.

BOOK REVIEWS

New Zealand: Inventory and Prospect. The 1956 Lectures to the Wellington Branch, New Zealand Geographical Society. ix and 133 pp., mimeographed. Wellington, N.Z., 1956. Obtainable from Department of Geography, Victoria University of Wellington, Wellington, N.Z. $1.00 postpaid. 10 x 8 inches.

These seven lectures will serve as an admirable introduction to the geography of New Zealand for those unfamiliar with that beautiful and geographically intriguing country but will also be helpful and illuminating to any student of its geography.

Professor George Jobberns of Canterbury University opens the series with a delightful essay in which he introduces you to his country and looks "back over the years I have known it myself and have seen it change." As New Zealand's senior geographer and the man who, more than any other, has led the development of one of the most active (per capita of national population, perhaps the *most* active) groups of geographers in the world, he knows his country and its geography as well as anyone can hope to know it. Widely remembered among American geographers for his perceptive wit, he conveys accurately, in a genial, reminiscent style, the flavor of his country and of the half century of change he has observed.

Mr. I. J. Pohlen of the N.Z.D.S.I.R.'s Soil Bureau next brings us up to date on the nature and significance of the country's soils, research on which has been especially active during the past two decades. Limits of time in his address lead him to some rather sweeping generalizations (e.g., implications of direct correlation of air temperature and soil texture) with which other pedologists might take issue, but few could challenge the accuracy of his descriptions of regional types and their significance for land use. Four of his seven accompanying maps are very welcome additions to our limited cartographic description of New Zealand's soils.

The third essay, on pastoral farming, which overwhelmingly dominates New Zealand's use of rural land, and contributes most of the exports of world's greatest (per capita) trading nation, was given by Director Smallfield of the New Zealand Department of Agriculture's Extension Division. His figures are impressive. Of some 43 million occupied acres, 31 million are under pasture and only one million are under crops; moreover, well over half of that grassland, and its major productive part, is in sown grasses. As he spoke, it supported some 40 million sheep and 6 million cattle (including 2 million dairy cows). Large holdings (over 1000 acres) accounted for two-thirds of the area but only 7½ per cent of the 92,000 farms.

Mr. Smallfield is happily able to report that a widely advertised and deplored deterioration of the sown grasslands, with inferior grasses replacing the high quality sward originally established (largely on burned forest land), has been arrested through a spectacular program of aerial top-dressing. Nearly 300,000 tons of phosphate fertilizer were so spread on nearly 3 million acres in 1955 (and these figures have been greatly exceeded in the following three years). Of even more interst to geographers will be his summary of the regional differentiation of the various types of pastoral farming.

Mr. N. E. Dalmer of the New Zealand Department of Industries and Commerce next reminds us, however, that secondary industrial development has caught and passed the agricultural and pastoral enterprise in terms of manpower employed and contribution to the net national income. His very full inventory of New Zealand's manufacturing activities is accompanied by a series of most informative charts and tables in the longest paper of the series.

A brief look at some aspects of the country's population geography, particularly in regional variations in age-pyramids, is undertaken by Mr. S. H. Franklin of Victoria University's geography department in the fifth paper. It is followed by a long-range look at New Zealand's overall industrial structure by Dr. W. B. Sutch of the Department of Industries and Commerce. From three decades of keen study of New Zealand's political, social and economic life he makes his shrewd observations and, as a profound student must, he asks more difficult questions than he can attempt to answer. His contribution neatly leads into the concluding paper of the series.

Prof. H. B. Low, senior agricultural economist of Massey Agricultural College, picks up the challenge of looking ahead to "The Next Twenty Years" in that paper and, in a brilliant summary, gives us many keen insights into what New Zealand is by his tentative, personal, conclusions as to what it may become. He has a most interesting discussion of the efficiency of New Zealand's farming and points out that, if the employed farming population were to remain at its 17 per cent of the total labor force, while the total population advanced to 3 million (a goal quite likely to be reached well before

the date of 1975 he tentatively sets), exports would have to be vastly increased. New Zealand's own needs for farming products are met by only 5 per cent of its total labor force. If the most efficient agricultural and pastoral production in the world were further improved so that the country's needs could be met by only 4 per cent of its labor force, New Zealand's exports would have to be nearly doubled by 1975. It would be unfair to report here more of Low's trenchant observations but, for any concerned about the economic future of New Zealand's staple-product economy, about which its own and other economists have been issuing doleful jeremiads, the restrained optimism of his conclusions may serve as a healthful tonic.

This small volume is in no sense a condensed encyclopedic look at New Zealand. Many facets of its geography and economy (e.g., the vastly increased production, processing and export from its exotic forests and the use of aerially spread weed-killers to improve pastures) are ignored. But for what it does have to say, its modest price makes it a tremendous bargain as a source of information and highly educated speculation about the present and immediate future of New Zealand.

ANDREW H. CLARK
University of Wisconsin

The Pattern of Asia, by NORTON GINSBURG (Editor). xiv and 929 pp.; maps, plates, tables, figures, index. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1958. Trade, $11.75; text, $8.75. 9 x 6 inches.

This tremendous work is the product of considerable team-effort by representatives of the post-World War II generation of American professional geographers. To produce this 929-page volume, six of these younger men, from as many different universities, collaborated for over five years; each wrote about the particular area of Asia in the study of which he had developed a specialization.

The 39 chapters of the book are organized into six large sections of differing lengths. The first is a general introduction to Asia (2 chapters by Norton Ginsburg). The second is concerned with East Asia (4 chapters—Introduction and Japan—by Ginsburg; 1 chapter—Korea—by Shannon McCune; 7 chapters—China and Mongolia—by Herold J. Wiens). The third section treats Southeast Asia (5 chapters—Introduction; Philippines, Malaya and British Borneo, Thailand, Indo-China—by Ginsburg; single chapters on Indonesia and Burma by McCune and John E. Brush, respectively). The fourth section deals with South Asia; the 3 introductory and 4 regional chapters are by Brush, with the chapter on Ceylon by McCune. The 8 chapters of section five on Southwest Asia are wholly the work of John R. Randall. The two concluding chapters, section six, dealing with the Soviet Union, are by Ginsburg.

Thirteen of the 39 chapters thus are by Ginsburg who also did the yeoman service of organization and editing. As he writes in his Preface: "The book . . . has a theme which makes it distinctive. It emphasizes the changing political and economic geography of Asia and attempts to illustrate the various problems and potentials of the countries of Asia. The purpose is to provide not merely a random description, but to point toward a more basic understanding of the processes of change which are radically transforming the Asian landscape." This volume will be fairly criticized for being too much "merely a random description." It dwells on the "Pattern[s] of Asia"; the singular title of the volume is almost neglected. Concluding or summary chapters of a systematic sort are absent.

Contributing to comparability and integration of the sections by different authors is the illustrative material (maps, photographs, tables, and plates), probably the outstanding contribution of the work. Allen Philbrick, as cartographer, has produced two 2-color end-papers and 40 black-and-white maps curiously distributed through the text. Of these latter, 9 are half-page, 20 are full-page, and 11 are two-pages in size. But whereas there are 6 maps on Asia as a whole, 9 maps on East Asia, 14 on Southeast Asia, and 9 on South Asia, there are but 3 maps on the Soviet Union and only 1 on Southwest Asia. The result is that the last 43 per cent of this otherwise well-illustrated work contains only 4 maps.

Ginsburg, in his Preface, indicates that: "The maps, for the most part, are very complex. . . . The maps were designed to act as references in themselves about which commentaries have been written. Thus, it is assumed that they will be referred to again and again, not simply as illustrations of what is written in words but as integral parts of the volume, worthy of continued study and interpretation." Excellent examples of the cartographer's art are the two land-use maps on Japan (pp. 88–89) and on India-Pakistan (pp. 512–513) which include not only 6 and 8 inserts, respectively, but also separate legends for these inserts. Another challenging map is that on the "Major Language Groups of Asia" (p. 30) which on one page depicts 26 distinct patterns.

A special characteristic of the work is the excellent use made of 168 photographs. The expensive "bleeding" technique extends most of the pictures to the edges of the page, thus providing maximum size of photograph by using otherwise blank-page margins. Most of the photos are half-page in size; more than two dozen are larger. Lengthy captions (a text within the text) average nearly nine lines per figure.

Ginsburg makes much of the "Asiatic Cres-

cent" or "Asian Asia" (the southern and eastern margins, excluding the USSR and central interior Asia). Except for Southwest Asia, this is identical with the areal coverage of J. E. Spencer's *Asia, East by South* (Wiley, 1954). The two works complement one another neatly. Whereas Ginsburg *et al.* are mostly concerned with meticulous depiction of contemporary economic-political regions, Spencer affords a more systematic treatment (physical and cultural) of things Asian, and provides a greater sense of time-depth in cultural evolution. Both approaches are necessary for understanding Asia today.

WILLIAM L. THOMAS, JR.

University of California, Riverside

Land Use in Hong Kong and the New Territories, by THOMAS R. TREGEAR. Monograph I of *The World Land Use Survey*, edited by L. DUDLEY STAMP. Geographical Publications Ltd., Hong Kong University Press, 1958. 75 pp.; color inset map. 12s. 6d.

This is a booklet rather than a book. It successfully aims to give a brief overall view of the major outlines of land use and the physical base on which they rest, doing so with a minimum of words and with little attempt at theoretical or empirical analysis. In some 70 pages of text, broken up by numerous charts and photographs, Professor Tregear has managed to include sketches of the Colony's history and social setting, geological structure and geomorphology, vegetation, climate, soils, water supply problems, major land use patterns, agricultural economy, system of land tenure, marketing, and fishing, together with some highly general conclusions on the future of agriculture and water supply. There is also a one-page bibliography, and a glossary of Chinese terms (several of the definitions, and occasional remarks in the text, are open to criticism and may suggest a certain naiveté about China which is too often characteristic of Hong Kong residents). A brief appendix lists sample social expenses of farmers; its place and value in this small volume with its wide range seem questionable.

On the whole, the limited job is well done; it is lucid, well written, and as comprehensive as possible in so short a space. It is in some ways a reasonable sample of British geographical writing in semi-popular style, with which most American geographic writing compares badly. Interestingly, but perhaps not surprisingly, the most sprightly and imaginative sections are those on physical geography. The treatment of land use itself and of the agricultural economy is for the most part of a rather pedestrian or cataloguing nature, though in justice it should be said that the author's stated objectives: ". . . to gather together in concise and clear form the basic data that are necessary to the town and country planner . . ." are generally well carried out and may not reasonably demand more than he has provided. For a wider audience, however, or for professional geographers, it is unfortunate that few or no comparisons are drawn with other similar situations elsewhere, and that there is little analytical treatment or use of theoretical notions. Remembering the size of the area treated, it is remarkable to have the author lift his gaze so rarely from what lies beneath his nose; but in the context of his assignment, this charge cannot be pressed.

Professor Tregear may have felt obliged to restrain his treatment to suit the dimensions of a pamphlet which must be clear, unequivocal, and brief enough to ensure that bureaucrats will read it. Here and there the reader catches the voice of a dedicated lover of the land, and is led to rejoice with Professor Tregear that ". . . all trees in the Colony . . . are Crown property and may not be felled without permission" (p. 31). Perhaps more than any area of comparable size, Hong Kong needs and can apply such a regulation. However, although damming and diversion of run-off water on slopes may lower the water table in certain areas and hence penalize farmers, as Professor Tregear stresses, it may tend to stabilize or even to raise the water table in other areas and indeed is sometimes done in part for this purpose; one might argue that stabilization of the water table is one of the major arguments for building reservoirs. Since this may not be relevant in Hong Kong, Professor Tregear does not mention it, an omission which, like many others that could be cited, is understandable but regrettable.

The land use map in color, tucked in a pocket in the rear cover, is as important and valuable as the entire text, and has profitted from the extensive survey work of Professor Tregear himself. With essential modifications, it uses the classification scheme developed for Stamp's survey of Britain. At a scale of 1:80,000, it gives a beautifully detailed (though poorly printed) picture of these few square miles whose factual outlines Professor Tregear has described with conciseness and clarity.

RHOADS MURPHEY

University of Washington

Trade Routes of Algeria and the Sahara, by BENJAMIN E. THOMAS. vi and 121 pp.; illus., maps, bibliogr. University of California Publications in Geography, Vol. 8, No. 3, Berkeley and Los Angeles, 1957. $2.50. 10¼ x 6¾ inches.

Dr. Thomas gives the purpose of this book as the examination of trade route developments in Algeria and the western Sahara and their interrelations with physical, economic, and political

geography. The study, which emphasizes the more modern phases of the subject, is focused upon the routes themselves and treats only secondarily the means of transportation employed, the traffic carried, and the individual hinterlands. It is based partly upon field work carried out during three trips to the area, and was supported by the United States Office of Naval Research and the University of California, Los Angeles. Before commenting upon the individual portions of the book, it may be stated that Thomas has achieved his stated objective admirably and that in doing so he has made a worthy contribution to geographic literature.

The book is divided into two parts, the longer one dealing with northern Algeria and the shorter with the western Sahara. In a brief introductory chapter, the author summarizes the effect of physical features upon trade routes of the two areas, notes the shift in focus for western Saharan routes from Morocco and Tripoli to Algeria resulting from the imposition of French control in Algeria, and outlines the major economic developments that have had a bearing upon trade routes in recent decades. Among these developments, he considers the French settler orientation toward production for export, the reorientation of trade toward the sea, the rise of port cities, the attraction of the area for tourists, and the contrasting land uses within the area and between France and Algeria as the important influences affecting the pattern of trade routes. This chapter suffers from excessive compression. The reader might also have appreciated a few quantitative landmarks, such as the growth of international trade, demographic data, and estimates of economic growth, to serve as background for ensuing discussions.

In Part I, devoted to northern Algeria, the author first examines the trade routes of pre-French North Africa, when the main arteries were centered upon Carthage. This and succeeding chapters are well supported by maps which depict specific developments or patterns existing at given periods. The 36 maps, some original and some compiled from other sources, in fact comprise one of the more significant contributions of the book. The next chapter describes the development of French roads from early military routes to the national highway system of the early 20th century. In the following chapter, devoted to the railway evolution, in which rail lines first tended to reinforce and then to supersede existing routes, sketch maps show the extent of rail development at decade intervals from 1870 to 1930. The absence of an adequate landform base reduces the value of these important maps. Thomas points out again and again the significance of terrain handicaps and the consequences that railways have in reducing the inhibitive influence of difficult barriers; rail lines drawn on a physical base map would have helped to emphasize these points.

The author next discusses the competition of motor vehicles and railways that developed in the 1920's and 1930's and the "coördination" program that was designed to divide the traffic so railroads, trucks, and buses could all exist and serve in their appropriate spheres. As elsewhere, the government found difficulty in defining "appropriate spheres," and it is to be questioned whether some of the restrictive measures taken may not have hampered rather than aided the general economy. The concluding chapters in this section deal with transportation during and after World War II and include an interesting section on airways in Algeria.

Part II of the study, devoted to the western Sahara, begins with a fascinating summary of the rise and decline of caravan routes in this area. The second chapter examines the impact on trade routes of the French conquest of the Sahara, discusses the long-debated trans-Saharan railway, which Thomas notes has been voluminously supported in intriguing "combinations of science, politics, and fantasy," and outlines the development of roads, rail lines, and airways in the Sahara up through World War II. The final chapter deals with postwar Saharan routes up to about 1956. Unfortunately, oil prospecting in the desert was in an early stage when the book was written, and the wealth of knowledge that has since been gained about trafficability of desert surfaces and the suitability of various vehicles for desert use could not be included. The statement (p. 246) that "Mineral deposits are rare in both the Sahara and the Sudan," must now apparently be scratched, and we may expect to see in the next few years more attention to Saharan transport, including pipe lines, than was forthcoming in the last few thousand. As background for these new developments, Thomas has provided an excellent summation of Saharan routeways up to the discovery of oil.

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